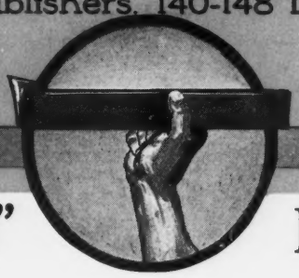
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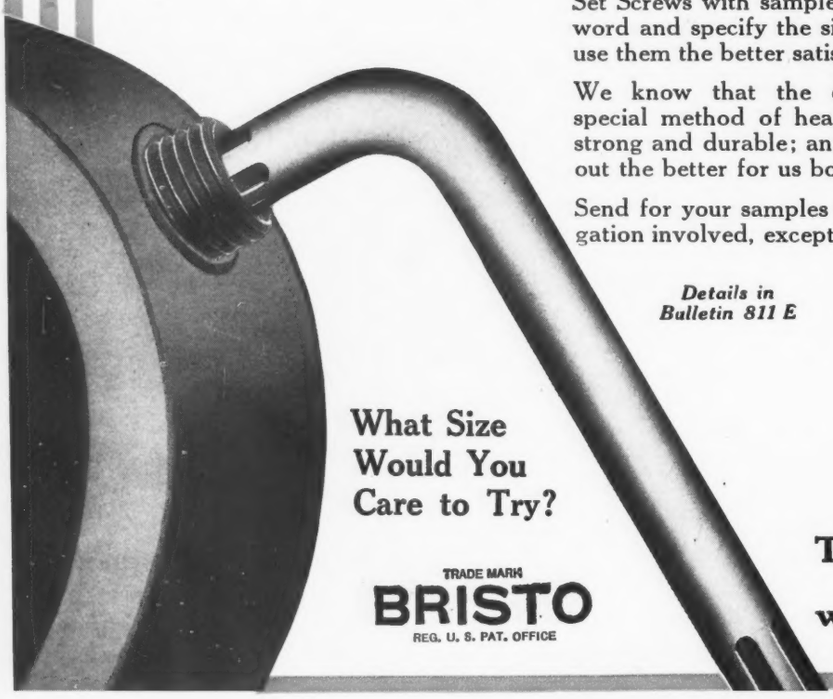
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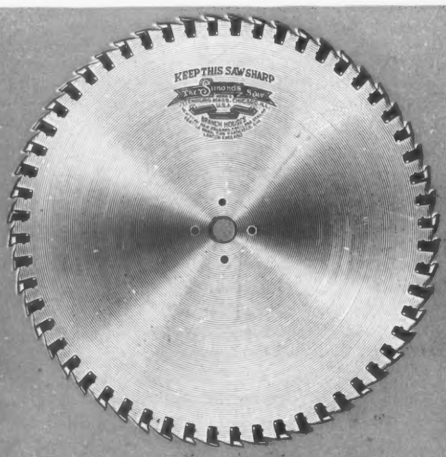
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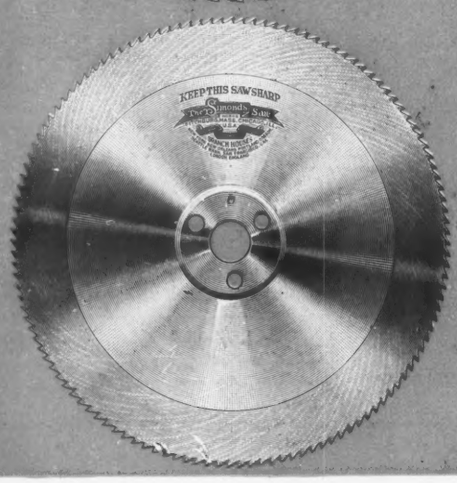


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Wire Forming



Section of a Wire-forming Shop

First of Two Articles Describing the Methods Used in the Manufacture of Wire Goods and the General Principles Applied in the Design of Typical Wire-forming Machines

WIRE can be bent, twisted, curled, upset, or otherwise formed into innumerable shapes. Greater liberties may be taken in the manufacture of wire goods than in making articles from metal in any other form. The possibilities are not limited by any special sectional shape of wire, by any particular material, or by any physical condition of the wire except extreme hardness. Iron and steel wire of various degrees of hardness are commonly used, as well as copper, brass, bronze, and precious metals.

The mechanical means for forming the wire are essentially the same for all materials, but the peculiarities of shape make it necessary to employ some interesting methods in performing the work, and some extremely ingenious tooling for the machines is used. Nearly every conceivable shape can be produced in wire by the use of the familiar type of wire-forming machine, supplemented in some instances, particularly where ribbon stock is to be formed, by the power press.

The various machines in common use are designed to operate substantially in the same manner. They consist fundamentally of four cam-operated slides arranged 90 degrees apart; these advance to a common center at which point a vertical member, called the "king-post," is located. The king-post is the member around which the wire is shaped by the dies or forming members that are carried in the slides. Obviously, the range of service of the machine depends upon the ingenuity employed in laying out suitable cams and in setting up the job. Considerable variation from the four-slide arrangement is practicable, because it is possible to mount auxiliary cams on each camshaft for operating levers and additional slides, so that pieces requiring more than four bending operations can be produced by thus increasing the scope of the machine.

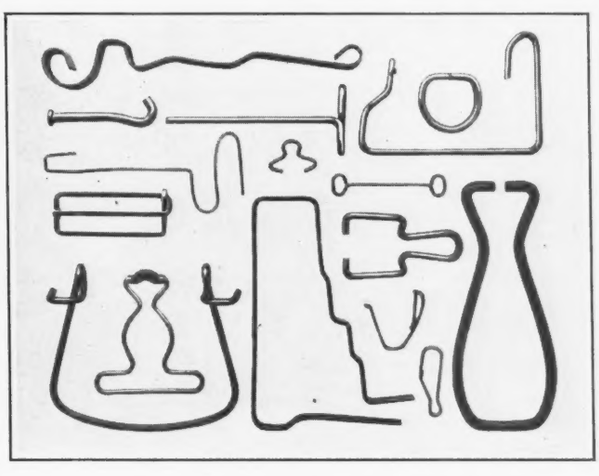


Fig. 1. Wire-formed Parts, showing Variety of Work

The forming dies themselves are simple in construction, and consist of finger members attached to the slides, usually provided with a groove at the end to receive and guide the wire as it is bent. Auxiliary levers are frequently interposed between the slides when extra bending members are required, and these are essentially of the same design as the dies except that they usually move independently of the slides. The grooves in the bending members are sometimes machined with wide mouths, so that the sagging wire may be brought against the angular surface and raised to the proper level, or the end of the wire may be brought to any desired plane to prevent interference with other parts of the wire, preparatory to the next operation.

The Eastern Tool & Mfg. Co., Bloomfield, N. J., whose practice is described in this article, has found it necessary to carry a great many different kinds of die steel on hand, in order to meet the requirements for manufacturing wire goods of varying material and design. Experience has shown that the design, as well as the kind of wire, affects the suitability of a steel for any particular die service. For a piece of work made from soft steel wire, having an average number of not too complicated bends, it is the usual practice to use 0.90 per cent carbon steel. Other steels commonly used for small spring wire work, which is particularly severe on the dies, and for forming hard wire and certain more difficult shapes, are chrome-vanadium and chrome-nickel steels. Widely varying com-

positions of each of these steels are regularly used, and they are, of course, carefully hardened and tempered, according to the specifications of the steel manufacturer.

The movements necessary to form a piece of wire into a more or less complicated shape may be varied in their sequence. The first consideration when a part is to be manufactured is the proper starting place in relation to subsequent operations. It has been found, even after large quantities of pieces have been manufactured commercially by one method, that greater production can be obtained by making certain simple changes which affect the entire cycle of the movements and completely revise the manufacturing procedure.

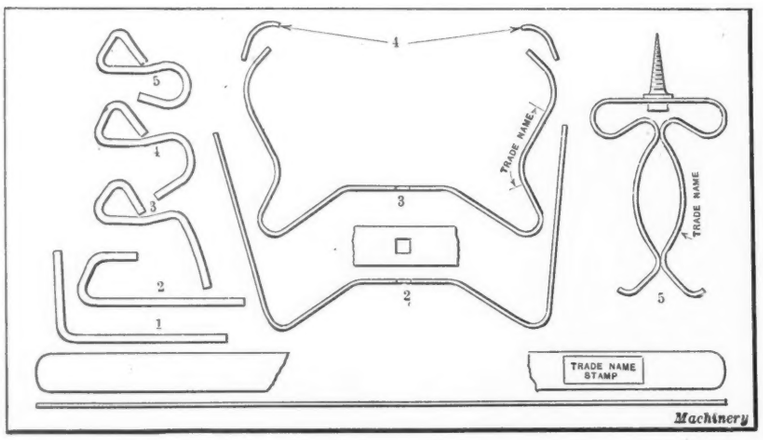


Fig. 2. Successive Shapes in the Manufacture of an S-hook and of a Holder made from Ribbon Stock

Order of Operations and Design of Tools

After the design of the piece has been studied and the number of operations required to produce it has been determined, it is necessary to arrange the order of operations and design the tools for each. If a complicated piece is to be made the use of auxiliary tools actuated by one of the regular slide movements should be considered. For example, it is common practice to use bellcrank levers as auxiliary forming members, and it should be the aim to operate these in the simplest manner possible. Although this may be done by the use of an extra cam, it can often be more simply accomplished by designing one end of the lever with a cam surface and the adjacent die with a suitable cam rise.

Again, if a curling or heading operation is to be performed, care should be taken to provide a temporary support for the comparatively slender wire. This may be advantageously accomplished by designing the cams so that the side tools will advance against the wire and remain there while the curling or upsetting die is in operation, thus holding the wire rigidly and preventing it from buckling under the end thrust. This is one method that has been successfully used, but the most available facility should, of course, always be utilized. It might even be desirable to design the curling or upsetting die with an extending member that will bear against the side of the wire and in this way steady the stock, but such a practice depends on the space available for auxiliary members.

The slides are regularly referred to as front and back slides and side slides. Most wire articles would naturally be produced by first operating the front die, although the peculiarities of design may be such as to make it advantageous to reverse the order and actuate the front die last, as is sometimes necessary in the manufacture of links and specially shaped hooks. In making wire goods from certain kinds of wire, such as spring wire, for example, allowances must be made for an over-travel of the stroke of the slide, which will take care of the natural spring in the wire, so that when it becomes set it will have the proper shape. The design of the work will suggest methods of forming it, and it will not be found difficult to arrange the tools so that they can work in different planes, if necessary.

Production may be facilitated by the ingenious design of the king-post. If a piece like a clasp is to be made, it is frequently possible to produce tension where the ends meet, by designing the king-post so as to make a bulge in the work, which may afterward be automatically straightened as the work is stripped from the king-post, and thus bring the two ends together in tension. Extensive application is made in wire bending of this principle of obtaining spring tension. In designing the king-post, it is well to consider what surfaces may be subjected to excessive wear, and to construct the king-post in sections that may be replaced.

Provision for Elevating the King-post

The king-post is usually assembled rigidly in the machine, but certain designs of wire goods make it desirable to provide for raising the king-post, as the final operations cannot be performed if the king-post remains within the formed work. A case of this kind is where flat stock is to be folded into a T-shaped paper fastener and it is necessary to elevate the king-post in order to permit closing the stock.

The grooves in the ends of the dies may be staggered or offset; by arranging these grooves properly in the various dies of a job, slight bends may be made, without regard to the direction of the sharper bends formed as a result of the slide movements. In forming an article that lies in one plane, it will commonly be found that the opposite ends of the wire will interfere, and some method must be used to displace one end temporarily while the other end is being bent over or under, as the case may be. This is sometimes done by attaching to the side of a die a separate piece which has an angular end so that the wire may ride up its inclined surface;

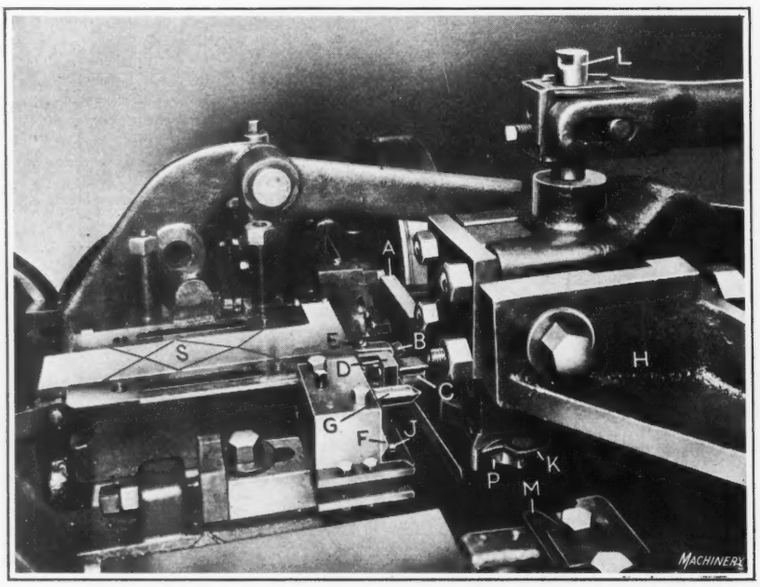


Fig. 3. Right-hand Side of a Wire-forming Machine equipped with a Punch Press Attachment and Dies for forming Ribbon Stock

or the interference may be avoided by using a sliding member to operate in the stationary king-post and bear downward against the wire.

It is often advisable to utilize the cut-off for a double purpose. The cut-off tool can be designed so that with one movement of the cut-off mechanism the stock will be severed and the end bent at the extreme downward travel of the tool. Sometimes this bend can be taken care of by attaching a separate piece to the side of the cut-off, especially if the bend to be produced is a considerable distance from the severed end of the stock.

It will be seen from the few phases of wire forming mentioned that the possibilities of varying the tooling arrangement to meet special conditions are numerous—so numerous, in fact, that it is impracticable to attempt to include all operating conditions here. Some of the points mentioned will now be brought out in describing the manufacture of a few articles of familiar design. The methods described have been selected with a view to presenting a rather diversified line of wire goods manufacture.

Forming an S-Hook

The S-hook shown in the upper left-hand corner of Fig. 2 is a simple example of wire forming without the use of auxiliary slides or special mechanical movements. As will be seen by the numerals, this hook is completed in five bending operations. The hook is made from No. 14 W & M gage (0.080 inch diameter) soft steel wire, tinned. The work is performed in a Nilson No. 0 four-slide wire-forming machine, in which it is first cut off and bent as shown, by a cut-off tool made in two parts; one part severs the stock and the other forms the right-angle bend. This is a case where the front die does not come into action first, and the reason for this will be readily understood by an inspection of the shape of the work and by following the description of the operations required to complete it.

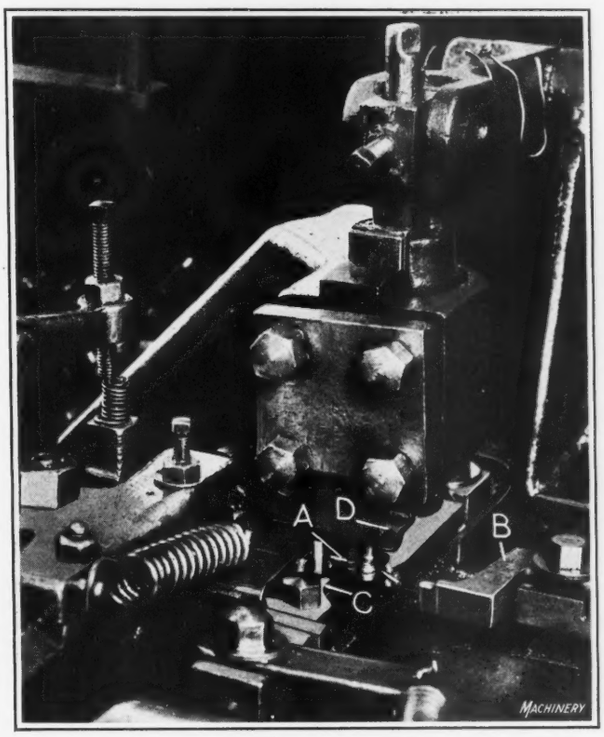


Fig. 4. Top of Wire-forming Machine showing Arrangement of Die-slides for making a Hook

The king-post has two separate members at its lower end, shaped to correspond to the loops in the hook, and the wire passes between these two members. The die on the left side of the machine then advances, bends the left end in the second operation, as shown, and recedes. The back die closes the triangular loop, and at the same time starts the bend for the hook end, but it cannot bend the hook end further than shown, on account of its position relative to the king-post. The right-hand die is next operated to produce the fourth shape shown in the diagram. This is the operation illustrated in Fig. 4. Here the position of the wire as it passes between the two members of the king-post may be seen at *A*, as well as the goose-neck shape of the side die *B* used to make the bend in the hook, which is offset relative to the loop in the opposite end.

Finally, the front die *C* advances and closes the hook end around the post, which completes the forming of the S-hook. The downward stroke of stripper *D*, which surrounds the king-post, then removes the work. Special designs of strippers may be employed to aid in forming the wire, as well as in removing it from the king-post, which will be referred to later. These S-hooks are produced at the rate of 7500 per hour, which is considered a very satisfactory production.

Flat Wire Forming

The manufacture of wire goods from ribbon stock may be properly classified as wire forming, but this work must often be supplemented by the use of a power press. Ribbon stock is handled in cam-operated slide machines of the same general type as those used for wire of other sectional shapes, and the tooling is not very different except where affected by the special design of the work. It is quite common, when ribbon stock is being worked, to employ a punch press attachment on the wire-forming machine, besides the regular slides. This makes it possible to perform many operations that would otherwise require a separate machine.

The piece shown at the right, Fig. 2, is a "three in one" holder suitable for suspending mop sticks and similar household articles. It is made from ½- by 0.041-inch extra-hard cold-rolled ribbon stock, and is stamped with the trademark, punched with a square hole and formed into the fourth shape shown in a Nilson No. 4 wire-forming machine equipped with a punch press attachment. This machine and set-up used for this operation are illustrated in Fig. 3. The slide *S* of the attachment (which has been exposed to view by the removal of the cover) is essentially the same in design as the slide of a power press. It is operated by a cam on the camshaft at the front of the machine.

The stock is fed in to a stop, and held in the correct relation to the dies by guides on the back-plate *A*. The back-plate corresponds to the bolster-plate on a power press. At one stroke of the punch-press slide the stock is cut off with rounded ends and stamped. The stamping die *B* and the cut-off punch *C* are located on the back-plate and are stationary. The cut-off die *D*, which produces the rounded ends on the stock, is attached to the slide member, and a piece of flat stock *E* is fastened directly above the die, extending forward and hooking down over it so that when the slide is advanced sufficiently the stock will pass between this piece and the face of the die. The purpose of this is to carry the end of the incoming stock backward after the blank has been cut off, and prevent its rounded end from catching in the curved surface of the punch.

The front bending die *F*, which is located in a slide at the right of the punch press attachment, then immediately comes into operation, bending the work against the plate *P* at the lower end of the king-post, to produce the second shape shown in Fig. 2, and at the same time punching the square hole. This hole must be located centrally in the stock. As wear is bound to occur in the slide, in order to locate the work accurately relative to the punch an auxiliary guide is employed in the form of a locating post *G*, shaped similar to a lathe center, which enters a bushed hole in the king-post. Wherever a king-post is used as a die-holder, as it is in this case, it is advisable to provide an additional bracket on the machine to support the king-post under the thrust of the punching operation. Such a bracket is shown

at *H*. The end of the punch can just be seen at *J*. The die for this punch is a separate steel block having a suitable bushing carried in the king-post.

The steel plate *P* is designed on the sides as required to produce the third shape, and the two side dies (one of which is shown at *M*) advance together to form the wire to this shape. It will be noticed, from Fig. 2, that a separate operation is required to turn in the ends of the stock. This is necessary because, in order to produce a permanent set in these ends, the bending pressure must be applied at right angles to the direction of movement of the side slides. The back die which is used for this operation is a plain rectangular-shaped member which contacts only at the ends of the stock. The formed wire is then removed from the forming plate by a stripper *K* of special shape, which, like most of the stripping mechanisms used on this kind of machines, is actuated by a cam that moves the post *L* by a cam-lever.

Power Press Bending Fixture for Ribbon Stock

As has previously been mentioned, the forming of flat stock often requires the supplementary use of a power press. Although the punch-press attachment for a wire bending machine can be made to perform all ordinary punch press operations, where a bend is to be made in comparatively long pieces of formed stock requiring considerable space for the sweeping ends it is usually advantageous to perform the work on a separate press.

A case in point is the final bending of these holders, and the equipment used on the power press for this operation is illustrated in Fig. 5. Here it will be seen that the ram of the Sidney press used carries two vertical posts in which rack teeth are cut to revolve two pinions in the base of the fixture and turn the bending cams *A* which are attached to the same shafts that carry the pinions. These cams are in the form of collars with projecting lugs *B* which bear against the work at the beginning of the operation in the manner indicated in the illustration. Previous to this final bending a square-shank wood-screw is assembled into the square hole punched in the work and headed over; use is made of this screw to locate the work symmetrically when bending. The screw is straddled by a slotted post *C* in the fixture, and two pins *D* extends from the base so that, when properly located, enough tension will be produced in the work to hold it rather tightly.

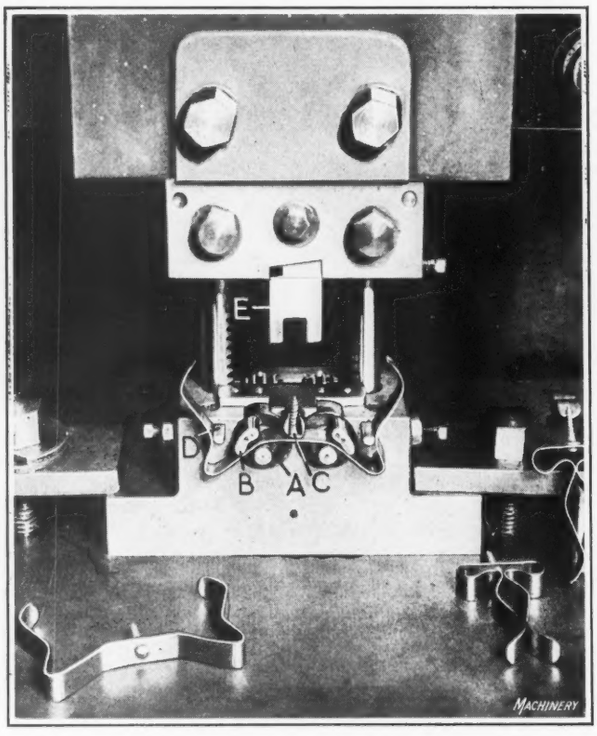


Fig. 5. Bending Fixture used on a Power Press

The bending operation itself is simple, and is of interest only in showing the transformation in shape which it is possible to realize by ingenious designs of bending fixtures. The downward stroke of the press ram results in lugs *B* bending the stock downward around the center posts, and sweeping the ends of the work around until the final shape is obtained. At this point the lugs, of course, are close together and shape the stock so that it touches directly below the head of the wood-screw. There is a tendency for the upper straight part of the stock to bulge outward due to this bending movement, so that an auxiliary die member *E* comes in contact with this part of the stock at the completion of the bend, and removes any bulge that may have been formed. An hourly output of 700 holders is attainable with this fixture.

The application of other principles of wire forming will be described in the second installment of this article, which will be published in September MACHINERY. Work of a more complicated nature will be described and illustrated, and views of the machines used and tooling lay-outs will be shown.

* * *

ACCURATE DESCRIPTIONS OF EXPORT SHIPMENTS

The Bureau of Foreign and Domestic Commerce of the Department of Commerce states that many glaring errors have been discovered in the statistics of exports for the first months of 1922, compiled under the new export classification which shows quantities in addition to values for every class. The records for previous years probably contained similar errors covered up in classes showing values only; for example, one lathe chuck at $3800 is mentioned; grinding and sharpening machines at $5 each, etc.

Investigation of the errors has disclosed that the majority are due to inaccurate description in the export declarations presented by the shipper or his agent at the custom house for clearance. Frequently inquiries have to be made at a great loss of time through collectors at distant ports in order to reach the original shipper and obtain accurate information for correction of the original reports.

One cause of inaccuracies is the practice of exporters to leave the preparation of the export declaration to forwarders or brokers at the port of exportation. The declaration should be prepared at the original point of shipment by a person having personal knowledge of the shipment. Preparation of export declarations should not be left to inexperienced clerks, who may not have a proper conception of its importance and regard it as a mere formality necessary to obtain customs clearance.

Exporters are urged to insert in the column headed "Class No. of Schedule B" on the declaration the number of the "Statistical Export Classification of 1922" under which they think the goods should be classified. This classification may be obtained upon application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. Treasury Decision 38410, containing regulations regarding filing of export declarations will also be furnished upon request. Compliance with these suggestions will eliminate the principal source of errors, facilitate compiling, and increase the value of the statistics to exporters.

* * *

The American Engineering Standards Committee has decided to undertake the development of a safety code for conveyors and conveying machinery. The National Bureau of Casualty and Surety Underwriters and the American Society of Mechanical Engineers have been appointed joint sponsors for this code.

CAVITY DRILLING TOOL FOR ENGINE CYLINDERS

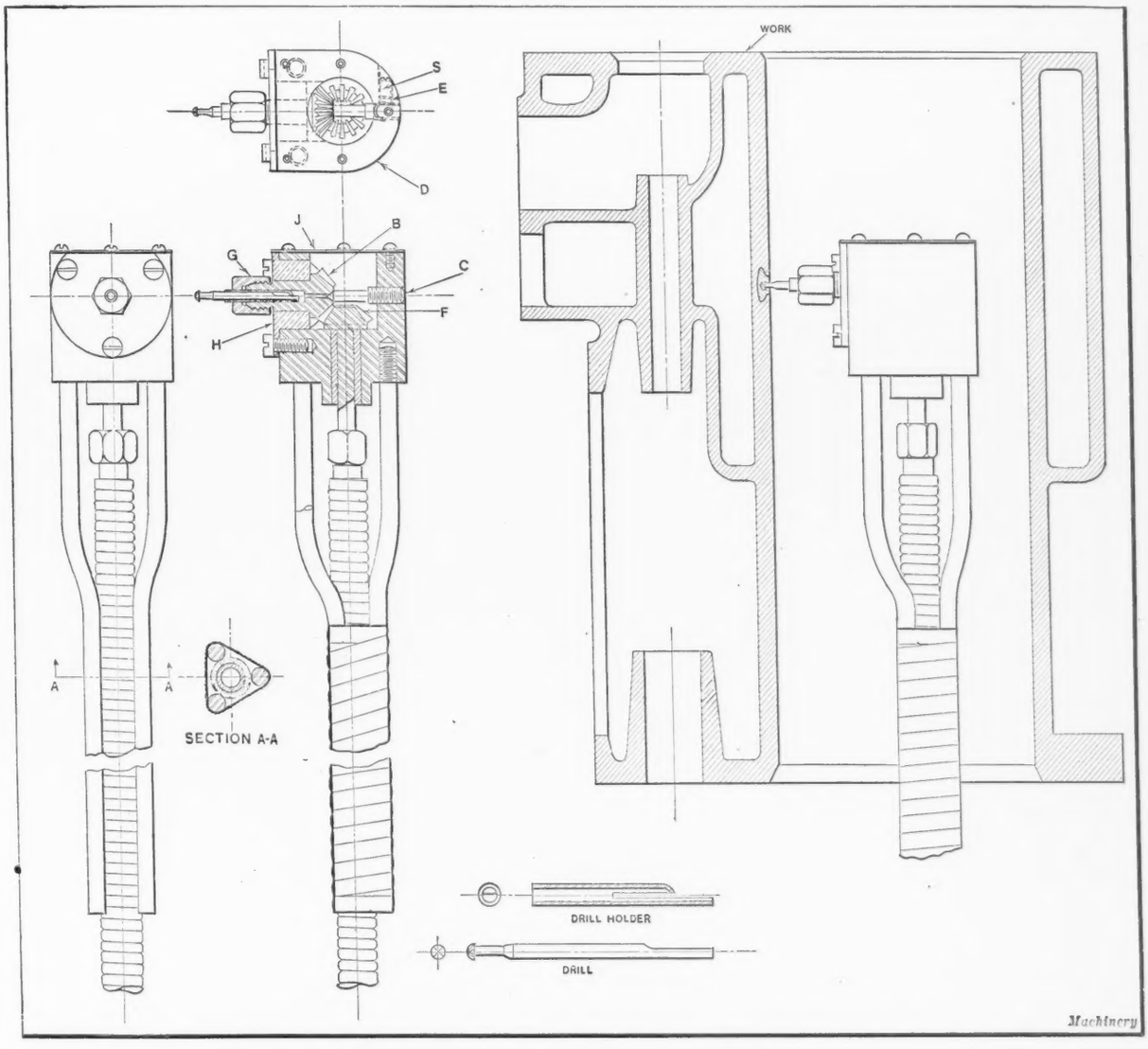
By CLARENCE M. SCHLEH

In the production of automobile engine cylinders it is customary to perform some of the machining operations before the final boring or grinding of the cylinder bore takes place. After the bore has been finished, the inspection department often finds little sand-holes or defects in the walls of the cylinder which could not be detected in the rough casting. In such cases the time spent on the former operations is entirely lost if no effective means of overcoming the defects are employed. Cylinders with defects of this kind, however, can be saved with little expenditure by cleaning out the cavities and then filling and closing them in by welding. The special drilling tool here illustrated has proved to be satisfactory for cleaning or drilling out the cavities preparatory to closing them in by welding. The cavity drilling machine is simple in construction and arrangement. It is equipped with miter gears which drive the drill, the gears, in turn, being driven by attaching the stem of one gear to the flexible shaft of a portable electric drill.

The drill itself is of a special design, of the type employed by dentists, as is shown in the small detailed view at the bottom of the illustration. This drill is slipped into the drill-holder, which is merely a small steel tube, the inside diameter of which fits the drill body. The holder is slotted at the rear end, and the upper portion is bent over and acts as a driver on the flattened end of the drill shank. The slot in the drill-holder gives it the spring tension required to hold the drill in place. A small chuck for holding the drill is provided by cutting a thread and turning a taper on the small end of gear *B*. Three slots spaced 120 degrees apart are cut in the end of the shank of gear *B*. When the hexagon nut *G* is drawn up tight, the tapered seat at the end of the threaded portion causes the slotted end of gear *B* to grip the drill-holder. Gear *B* has a flanged bronze bearing *H* which is held in place by three fillister-head screws.

At the large end of this gear is a center hole which fits the tapered end of the thrust screw *C*. This screw is inserted in a threaded hole in the gear-box *D*, being located directly opposite, and in line with, the gear center. The thrust screw is screwed in until the proper adjustment is obtained. It is then locked in place by the brass plug *E* which is pressed against it by tightening the headless set-screw *S* placed at right angles to the thrust screw. The driving gear *F* has a long shank, the diameter of which is turned to fit the chuck on the end of the flexible shaft of a portable electric drill. This gear is also provided with a brass bushing which is pressed in to the bottom of gear-box *D*.

The gear-box is made of a piece of cold-rolled steel stock, and is counterbored at the top to receive the driving gear *F*. A hole is also bored at right angles to that provided for the driving gear to receive the driven gear bushing *H*. The back of the gear-box is rounded, as shown in the plan view, to



Tool for drilling out Sand-holes or Other Cavities in Automobile Engine Cylinders

permit a greater working space. The size of the gear-box is limited by the diameter of the cylinder, and must be made small enough to permit proper manipulation of the tool. An oil-tight gasket is placed under the flange of bushing *H*. After the gears are put in place and screw *C* properly adjusted, the gear-box is packed with grease. The cover *J*, is then screwed down on an oil-tight gasket.

Three threaded cold-rolled steel rods are screwed into tapped holes in the bottom of the gear-box. These rods are made so they will extend beyond the casting far enough to form a handle. These rods are bent inward and placed against the outside covering of the flexible shaft of the electrical drill. The three rods and the flexible shaft covering are wrapped together with tape as shown at *A*–*A*. It is necessary to make the handle longer when the tool is to be used for cylinders not of the detachable-head type, as the drilling tool in such cases can be entered at only one end.

The view at the right-hand side of the illustration shows the manner in which the tool is employed to clean out a cavity in a cylinder. When the defect in the cylinder is located, the drill is placed in the cavity and after being properly entered is shifted or manipulated in such a manner as to form a pocket beneath the surface, which is larger than the opening of the cavity. This is accomplished by means of the specially designed drill point. When the pocket has been cleaned out sufficiently, it is welded shut, being completely filled in with metal. As the maximum thickness of the cylinder wall is about ¼ inch, care must be taken not to drill too deep. This may be easily avoided by securing the drill in its holder in such a position that only the allowable working depth protrudes. The end of the holder will then suffice as a stop for the drill. The enlarged pocket beneath the surface of the cylinder prevents the metal from working out should it by any chance become loosened. By this means the danger of doing severe damage to both the cylinder and the piston, is eliminated. The surface of the cylinder wall where the cavity is closed in is carefully smoothed off and the cylinder given a final boring or grinding operation. Thus the time, labor, and cost of the preliminary machining operations are not a total loss.

TOOLING FOR PITCHER PUMP CYLINDERS

Some very interesting special machine equipment and tooling for finishing the interior of pitcher pump cylinder castings is employed by the Goulds Mfg. Co., Seneca Falls, N. Y. Fig. 1 shows a battery of Prentice drilling machines tooled for boring, reaming and facing the small end of these castings. Instead of using the regular drilling machine table, the vertical ways of the drilling machines are equipped with a special clamping and supporting device, which is operated by handwheels at the sides. The castings are inverted and located on a seat *A*, which is clamped in the lower jaws by means of the handwheel at the left. This handwheel operates an opposite-hand screw so that both jaws are moved simultaneously.

The jaws are provided with outboard supports in the form of posts, and after this cast-iron seat has been set up for a particular size of pump casting it is not changed. The small end of the casting is clamped by a pair of jaws at the top that are operated similarly to the lower jaws, this arrangement assuring a true vertical position for the work. The seat is so located in the lower jaws that the work is properly aligned with the combination boring-bar. The upper clamping mediums are also provided with posts to support them.

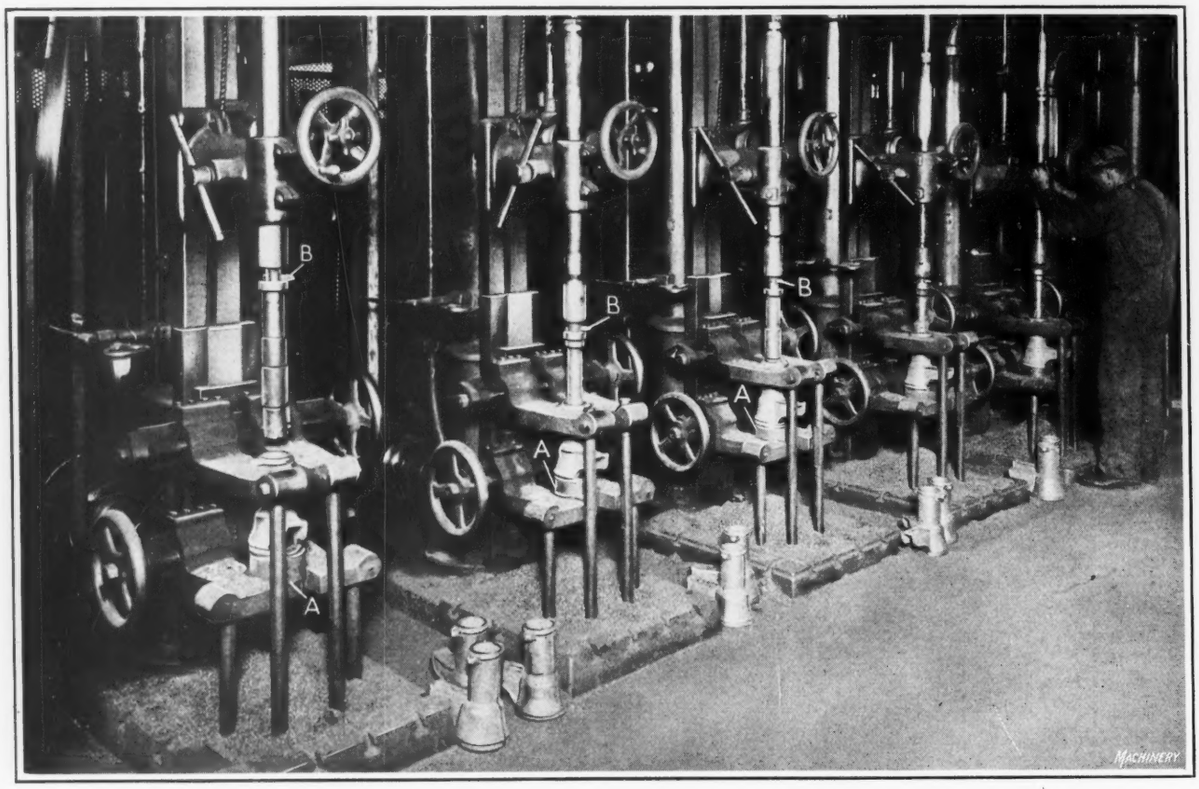


Fig. 1. Battery of Drilling Machines with Special Equipment for boring and facing Pitcher Pump Cylinders

A special extension boring-bar is used which has at the end five steel bits for stocking out the rough castings. After these have fed into the bore a few inches, three blades just above the stocking cutters finish-ream the holes. These two sets of cutters feed down through the casting until a fly-cutter *B* near the shank of the tool faces off the end of the casting. Directly under this cutter there is a floating collar which fits the finish-reamed hole preparatory to facing so that the end will be finished square with the cylinder bore. There are eight machines in this battery equipped as described, and they are all operated by one man who, by arranging the feed of successive spindles properly, may go from one to the other loading and unloading without loss of time. By this means a production of from 700 to 850 castings is attained in a nine-hour day.

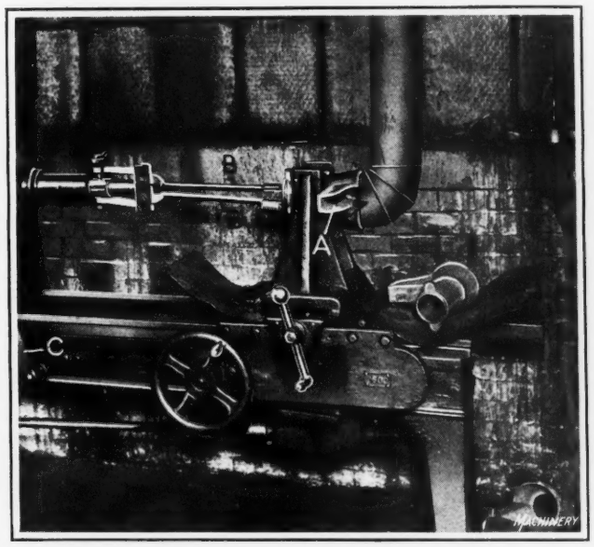


Fig. 2. Lathe equipped for grinding the Bores of Pitcher Pump Cylinders

The pitcher pump cylinder castings are ground on the bore with the lathe tooling shown in Fig. 2. Here it will be seen that the pump casting *A* is clamped in position, and aligned with the spindles of the machine by two special high cast-iron jaws. These jaws are operated by an opposite-hand thread cross-feed screw actuated by the handle shown at the front of the lathe. This entire unit—jaws, cross-slide, and apron—is special equipment applied to this lathe bed. The polishing tool consists of two pivoted arms *B*, on the end of each of which there is attached an emery pad. The arms are loosely held in a suitable holder in the machine spindle, and the pads on the extreme end may be spread to suit the diameter of the work being ground, by a screw adjustment at the opposite end of the arms. In grinding the work, the operator first closes the ends of the arms so that the pads will enter the hole in the casting and then advances the special carriage that carries the work, by means of lever *C*. The carriage movement is actuated by a rack and pinion.

The centrifugal force produced by the revolving spindle causes the arms carrying the emery pads to spread radially outward, so that as the carriage is fed toward the machine spindle the hole is ground. An exhaust pipe fits into the top of the cylinder castings to carry away the cast-iron dust produced in this operation.

* * *

THE WORLD'S MACHINERY TRADE

The present position of Germany as a competitor in the world's machinery markets has been considerably over-rated, according to William Althoff, assistant chief of the Industrial Machinery Division of the Department of Commerce. Mr. Althoff has compiled a review of the world's machinery trade in which he shows that while Germany held the first place in machinery exports from 1910 to 1913 inclusive, the United Kingdom following second and the United States third, in 1920 the United States ranked first, the United Kingdom second, and Germany third; and in 1921 the United States and the United Kingdom were practically on par, with Germany third.

The United Kingdom alone of the four leading machine exporters—the United States, the United Kingdom, France, and Germany—shows an increase in its exports in 1921, due mostly to large shipments of textile machinery. Although the machinery exports from the United States fell off considerably during 1921, in value they exceeded the exports in 1918, and were more than twice as great as the exports in 1913. The value of machinery shipped from Germany in 1921 was only two-thirds the value of the machinery exported in 1913.

Fundamental conditions at present existing in Germany are such as seriously to impair its position as a competitor in the world's machinery markets. To a large extent present low costs have been the result of direct and indirect government subsidies which the German Government must necessarily abandon. Government control as applied to grain prices has already been abolished, bringing about a general movement for higher wages. Freight rates and raw material prices are rising rapidly, and labor difficulties are becoming increasingly numerous; and there is a shortage of both coal and coke. These and other factors make it practically impossible to quote firm prices for long-term commitments. The tendency now is to quote prices subject to increases to cover any enhanced production costs that may occur before the goods are delivered.

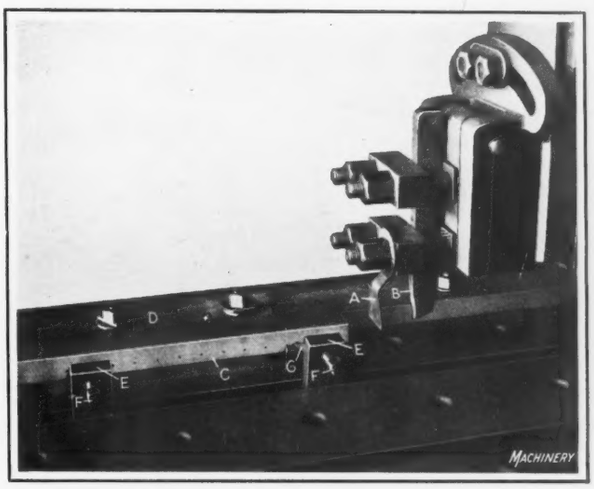
The complete review together with tables showing the exports from the four leading countries mentioned may be obtained upon application to the Industrial Machinery Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

* * *

PLANING MEASURING MACHINE BARS

On the Woodward & Powell planer, which is shown in the accompanying illustration, engaged in machining bars for Pratt & Whitney measuring machines, the chief point of interest is the application of a sheet-metal brush *A* which runs over the work ahead of the cutting tool to remove chips from the surface, so that there is no tendency for the tool to ride up over the chips and cause them to roll and damage the surface of the work. The illustration does not show clearly the form of the cutting tool *B* used on this job. The impression might be gathered that this tool cuts with its narrow end surface, but as a matter of fact the cutting edge extends along the broad surface at the rear of the tool, as it is shown in the illustration, and this edge is inclined at an acute angle to the direction of the table travel in order that it may have an efficient shearing action and produce a smooth finished surface on the work.

A string of castings *C* is clamped against a parallel bar *D* that runs down the center of the table, the same arrangement of stops *E*, clamping bolts *F* and "butters" *G* being employed as in the case of the slide gibs. Only one cutting tool is employed, but two rows of measuring bars are set up on the planer table, as experience has shown that time can be saved by setting up a large number of pieces of work, so that while they are being machined the operator can attend to one of the other planers in the department. On this job the depth of cut is 0.006 inch, as it is desired to obtain a very fine finish. The feed is ⅛ inch per table stroke, and the cutting speed 25 feet per minute.



Finish-planing Operation on Pratt & Whitney Measuring Machine Bars

Grinding in the Automotive Industry



Methods of Grinding Steel Balls and Ball Bearing Races—Grinding Roller Bearing Cups, Cones and Rollers—Second Article of a Series

By The Engineering and Educational Departments of the Norton Co., Worcester, Mass.

IMPORTANT grinding operations, such as are commonly encountered by manufacturers in the automotive field, were dealt with in the preceding installment of this article in July MACHINERY. Many of the parts used in the automotive industry, such as ball and roller bearings, springs, wheel rims, etc., are purchased by automobile manufacturers ready for assembling. Grinding as applied to the manufacture of these parts constitutes as important a series of operations as those in the automotive manufacturing plants, and grinding processes are employed for the same general reasons. In the case of such parts as ball and roller bearings, all of the finishing operations after hardening are done by grinding, because this is the only economical method of obtaining the required finish and accuracy. In the manufacture of such parts as leaf springs and wheel rims, however, grinding is employed because of the ease of application of the work to the grinding wheel and the resulting rapid removal of stock.

Instead of attempting to describe the grinding of a large variety of miscellaneous parts, a few of the more important operations will be dealt with. One or two of the standard makes of the various parts will be selected as typical, and the grinding operations used in their manufacture will be described. Where this description includes the make of grinding machine employed, it should be understood that other makes of machines of the same general type and capable of adaptation to the work could be used.

There are many types of ball bearings, but the interesting grinding operations are similar regardless of the type. In this article the grinding involved in the manufacture of the annular or radial type of bearing will be referred to specifically. The manufacture of steel balls for bearings is an art in itself. The mechanical equipment and problems are different from those in most manufacturing plants. On this account steel balls are frequently the only product manufactured by a concern. Typical grinding operations necessary in the manufacture of steel balls are described as follows:

Dry Grinding Operations on Steel Balls

The ball blanks, which are cold-headed for small sizes and hot-forged for large sizes, are subjected to a rough-grinding operation before they are heat-treated. This rough-grinding, which is done dry, removes a considerable part of the surplus metal, for the headed balls have a ring or fin around them left by the heading machine. As a result of this operation, each ball is brought to a much closer approximation of a truly spherical form than it is possible to obtain in the blank form made by either the cold-heading or hot-forging processes. Rough grinding also removes the decarbonized steel from the surfaces of the hot-forged blanks.

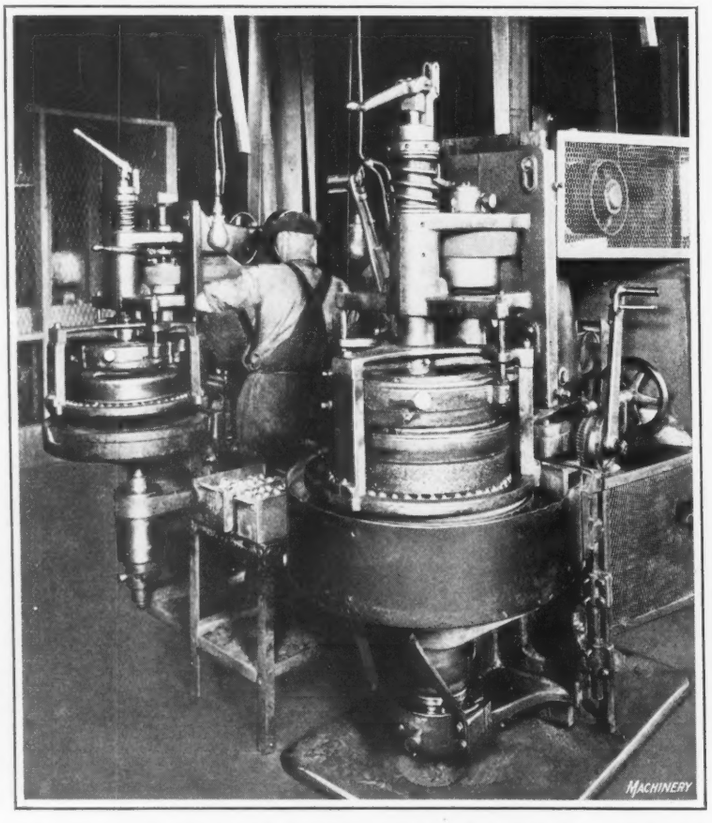


Fig. 1. Vertical Type of Machine used for rough-grinding Steel Balls for Bearings

The machines used for rough dry grinding are of the Grant type. A grinding wheel of the cylinder or ring type is mounted on a flat plate which is shown in the illustration Fig. 2. This plate, in turn, is mounted on the top of a vertical spindle, and rotates in the opposite direction to that of the driving or chaser ring *A* which presses down on the balls and keeps them in contact with the wheel. The inner and outer containing rings *B* and *C* are two concentric rings of different diameters, and are supported above the grinding wheel by springs. They are so beveled that the balls are held in a way that

allows them to project slightly through the space between the beveled edges, and thus to be brought in contact with the grinding wheel.

The grinding wheel has a surface speed of about 5000 feet per minute, while the driving ring revolves in the opposite direction at about 60 revolutions per minute. The containing rings and grinding wheel are set eccentric to each other so that the balls, as they are rolled around the containing rings by the driving ring, travel across the top of the grinding wheel face. The side pull of the wheel on the ball constantly changes the axis upon which the ball rolls, and a new surface is constantly being presented to the grinding wheel. The result of the grinding is to produce a surface which is a close approximation to spherical form.

The grinding operation is not wholly automatic. The amount of pressure between the balls and wheel is controlled by a hand screw which raises the wheel-spindle. Only one ring of balls is ground at a time. The containing rings are filled with balls which are put in so that they touch each other, and while one charge of balls is being ground a second is being made ready. A gage indicates when the balls are ground to size.

After being rough-ground, the balls are heat-treated and hardened, then returned to the dry grinding department for the finish dry grinding operation. This operation is performed in the same manner and on the same type of machine as that employed in rough grinding, only a finer wheel is used, which removes the scale and brings the diameter a little closer to the desired finished size.

For rough dry grinding No. 40 grain wheels are used, while No. 60 grain wheels are used for finish dry grinding the large balls, and Nos. 90 or 100 grain wheels for grinding the small balls. The grade of wheel required is usually the hardest that it is possible to produce by the vitrified process. The point contact which exists between the wheel and the work results in a very high unit pressure, and this causes a severe dressing action, which softer wheels cannot withstand. Aluminous abrasive wheels are employed and they are operated at surface speeds ranging from 4500 to 5000 feet per minute.

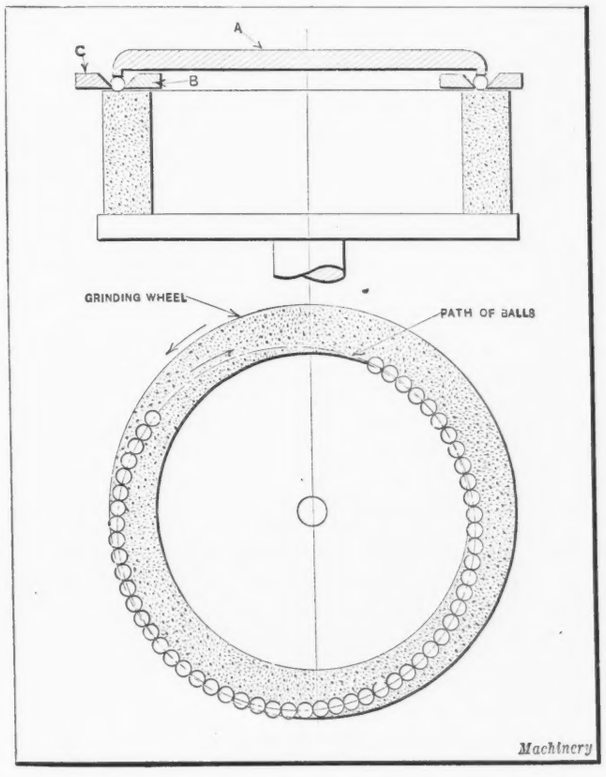


Fig. 2. Diagram showing Principle of Rough-grinding Operation

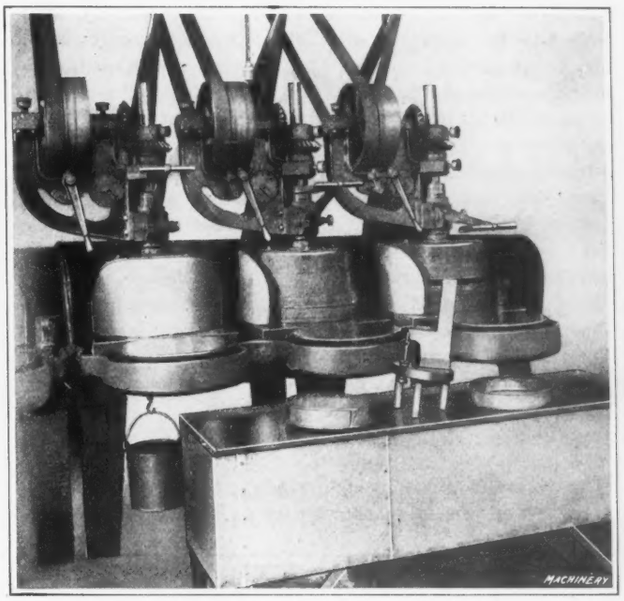


Fig. 3. Oil-grinding Machines, which are one Type used for finishing Steel Balls

The finish dry grinding leaves the balls in approximately spherical form, but with surfaces covered with small flat spots and scratches caused by the grinding wheel. There is still a considerable amount of excess metal on the balls, as they are about 0.010 inch over the finished size. The process of "oil-rolling" is for the purpose of removing the flat spots and scratches and bringing the balls down to nearly the proper size. The balls are tumbled in an iron barrel containing oil and No. 36 silicon carbide abrasive grain for from twenty to thirty hours, according to the amount of stock to be removed. The result of this operation is the production of practically perfect spheres, which are about 0.004 inch larger than the required finished dimension. This size is determined by selecting balls at random and measuring them with micrometer gages, the oil-rolling process being continued until they are 0.004 inch over the finished size.

Oil-grinding Steel Balls

The balls are reduced to the final size in oil-grinding machines (Fig. 3). The grinding part of these machines consists essentially of two iron rings, each of which contains an annular groove of such a size as to admit the balls. The balls roll in the groove of the lower of the two rings, which also contains oil and abrasive of the same kind as that used in the oil-rolling process, and are held by the upper ring. The upper ring is attached to a spindle and revolves the balls around in the groove containing the oil and abrasive. The grinding machines are provided with clock dials which, when the machines are started, are set to the approximate time when the grinding operation will be completed. Just previous to this time, balls are selected at random and measured for size. The time of grinding is usually from twenty to forty-five minutes, and the machine requires but little attention, except possibly to add more of the silicon carbide abrasive to the mixture.

Following the oil-grinding the balls are tumbled with hard wood sawdust, then with oil and Vienna lime, cleaned by being tumbled with hard wood sawdust again, and then tumbled with strips of kid leather, which completes the process.

Hoffman Process of Grinding Steel Balls

The final grinding operation on balls produced by the Atlas Ball Co. is performed on a Hoffman machine rather than on an oil-grinding or lapping machine, as it is claimed that more accurate results can be secured through this method. The oil-lapping machines are employed only on

balls over ½ inch in diameter to remove some of the stock left for finish-grinding, these machines performing this operation more economically than has been possible on Hoffman machines because of the high grinding wheel cost with the latter. However, the difference in cost is not great, and, consequently, oil-lapping is omitted on balls less than ½ inch in diameter, and sometimes on the larger sizes.

The balls are produced from bar stock either by cold-heading, hot-forging, or hot-pressing, the process depending upon their size. Balls over ½ inch in diameter are next annealed, rough-ground, hardened and tempered, rough-ground once more, oil-ground or lapped, finish-ground, and polished. Balls less than ½ inch in diameter are ground before hardening on Hoffman machines after the first rough-grinding operation, then heat-treated and finish-ground on Hoffman machines.

Rough-grinding Operations Preceding Finishing Process on Hoffman Machine

The first and second rough-grinding operations are performed dry on vertical machines such as illustrated in Fig. 1, or horizontal machines of the type illustrated in Fig. 4. On the vertical machines the grinding wheel is located beneath the balls and is dropped to permit their removal at the completion of an operation. On the machine at the left, the grinding wheel is shown in the dropped position. These machines operate on the same principle as the Grant type of machines, the general arrangement illustrated in Fig. 2 being employed.

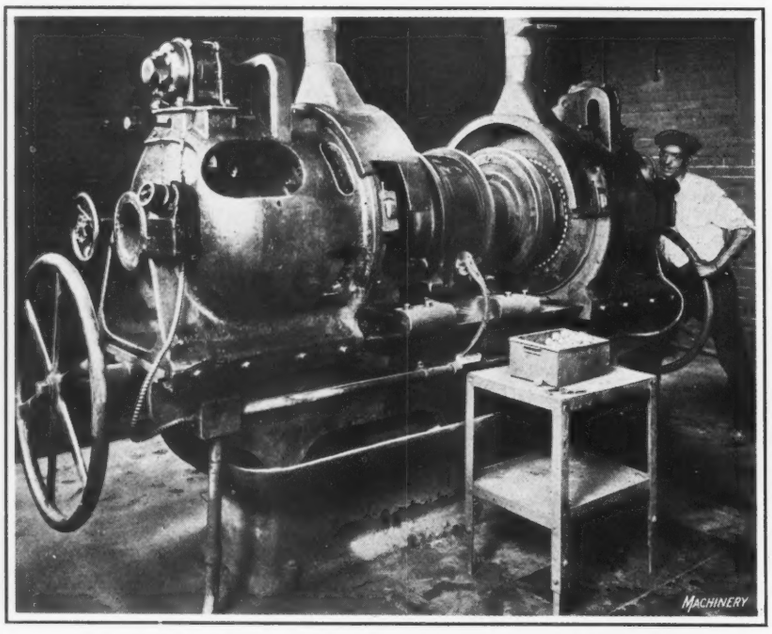


Fig. 4. Horizontal Type of Machine used for rough-grinding Balls varying from ½ to 2½ Inches in Diameter

After a load of balls has been ground, the vertical lever at the rear of the machine on the right side is used to lower the grinding wheel. A tray attached to the left side of the machine is then swung into position above the grinding wheel. The lever at the top of the machine is next operated to lower the inner of the two rings forming the groove in which the balls rotate, and thus permit the balls to fall upon the tray. After the latter has been removed and the inner ring raised, both the outer and inner rings are dropped together a sufficient amount to permit unground balls to be poured between the driving and groove rings. When the machine has been loaded, the groove rings are raised to bring the balls in contact with the driving ring, after which the machine is ready for raising the grinding wheel into contact with the balls.

Grinding wheels of from 40 to 60 grain, according to the size of the balls, are employed for the first rough-grinding operation which lasts about eight minutes. In the second rough-grinding operation wheels of 60 to 90 grain are employed. An operation on ½-inch balls in which 0.005 inch of stock is removed, averages six minutes.

The horizontal machine illustrated in Fig. 4 is used for grinding balls from ½ to 2½ inches in diameter. It is supplied with a hopper when balls from ½ to 1 inch are being ground, but larger balls are fed by hand. The design of this machine is based upon the same principle as the vertical machines illustrated in Fig. 1. It consists essentially of a bed, a duplex wheel-head and two sliding work-heads. The wheel-head consists of a motor having a long armature shaft, both ends of which are provided with flanges for attaching ring grinding wheels. The wheel-head is stationary on the bed, the work-heads being adjusted to bring the balls into contact with the wheels by means of a large handwheel at each end of the bed. In this illustration the balls of one head can be seen projecting through the groove formed by the two stationary plates.

Final Operation on the Hoffman Machine

The first Hoffman machine was designed to use abrasive grain for grinding. The balls were rotated between two grooved metal plates, together with a mixture of abrasive grain and oil covering the balls. Soft spots in the plates caused them to wear unevenly, making it necessary to repair or replace them frequently. The present Hoffman machine consists of a grinding wheel mounted on a horizontal spindle (Fig. 5). Opposite the grinding wheel is a stationary "rill plate," on the inner face of which (toward the grinding wheel) are a series of concentric annular grooves. The number and size of these grooves depend upon the size of the balls to be ground. In general the grooves are of such a depth as to admit one-third of the surface of the balls being ground.

The balls are fed into a runway which connects with the grooves in the plate, and under the action of the grinding wheel they rotate and roll around in the grooves until they have nearly completed one revolution, when they are thrown out into a trough and brought back into the runway to again pass through the grooves. The function of the trough is to mix the balls so that they will not be ground wholly in one groove, but each one will pass through all of the grooves, and in this way a more truly spherical ball will be produced. After the grinding wheel has been used for a time, grooves are worn in it corresponding to those in the metal plate. These grooves are allowed to become of practically the same depth as those in the metal plate, and are then maintained at this depth by dressing the surface of the wheel occasionally.

The grinding wheel is located close to the rill plate and revolves at slow speeds of from 30 to 60 revolutions per minute. At a certain point slots are cut through the rill plate through which fingers project to remove the balls from the grooves as the balls reach the fingers. When the balls leave the rill plate they are carried by gravity to a large magazine at the opposite end of the machine. A conveyor in this magazine carries the balls to a higher level from which they are once more returned by gravity through slots in the rill plate beneath the removing fingers and back into the grooves of this plate.

As a charge of balls is left for hours in one of these machines, each ball is carried many times through the different grooves of the rill plate. The illustration shows the balls

in the trough which conveys them back into these grooves. Toward the end of an operation, balls from the charge are compared on a minimeter every ten minutes to ascertain whether they have reached the required diameter. A pressure of about 7000 pounds is maintained on the balls during the operation. This pressure is secured by means of a screw extending through the center of the wheel-spindle and the magazine to the right end of the machine where a hand-wheel is located for tightening or loosening the screw against a heavy spring. By locating the screw as mentioned, a uniform pressure is placed on all balls in contact with the wheel. There is no slipping or twisting of the balls because of this pressure.

The grinding wheel has an outside diameter of 24 inches, a hole 12 inches in diameter, and is 4 inches thick. As many grooves are cut in a rill plate as can be spaced across the ring wheel between its hole and periphery. The number of grooves ranges from two to twenty-eight, according to the size of the balls for which the plate is intended. The magazine permits the machine to be loaded with charges of balls averaging 240 pounds. With a charge of ½-inch balls, approximately 1½ hours are required to remove 0.001 inch of stock. Kerosene is used as a coolant, because it has been found that with this oil all sliminess on the balls is eliminated and that the abrasive particles loosen completely from the balls and are carried away by the kerosene. The abrasive particles also settle readily to the bottom of the filtration tanks.

The finished product of the Hoffman machine is of much better quality than can be produced by finish-grinding on other types of machines. The production is, however, much lower; furthermore, it is impossible to grind in this machine the rough ball blanks as they come from the forging or heading machine. Very fine, hard wheels are used on the Hoffman machine, the grain size being generally XF and the grade as hard as it is possible to make by the vitrified process.

Grinding Outer Rings of Ball Bearings

The outer soft steel rings of ball bearings are turned products, usually made on screw machines. The groove is roughed out and the ring is then ready for its first grinding operation. This consists in surfacing the sides of the ring on a surface grinding machine of the vertical-spindle type, such as the Blanchard, shown in Fig. 6, or Pratt & Whitney, or by the use of special machines which have been designed by manufacturers of bearings for this particular class of work. These special machines are similar to the Gardner or to the Besly double-head machine. The bearing is held in a special fixture and rough-ground to the proper thickness by the use of two wheels, one grinding on each side.

After being surface ground, the rings are hardened and finish surface ground on the same type of machine as that used in the first grinding operation, but with different grinding wheels. The rings are then mounted in gangs on arbors and ground cylindrically on ordinary plain cylindrical grinding machines (Fig. 7). In some cases, the rings are roughed on one machine and finished on another, but in other plants the operations are combined. The ordinary wheels used for cylindrically grinding hardened steel are generally used for this work, although the finish required may be better than the ordinary commercial finish. The requirements as to finish may make it necessary to use a No. 60 grain wheel in place of the more common No. 46 and 24 combination wheels. No. 36 combination grain wheels are also employed.

Grinding Grooves in Outer Rings

The grooves in outer ball-bearing rings are next rough-ground on special machines of the oscillating work-head type. The Van Norman automatic radial raceway grinding machine is shown in Fig. 8 grinding a large outer ring. After this machine has been set up and the work placed in the work-holder, the wheel is brought in contact with the raceway, after which the groove-grinding operation is entirely automatic. It is possible for one man to operate several of these machines.

For the groove grinding of outer rings, two wheels should be used—one for roughing and another for finishing. Vitrified wheels made up of grain No. 46 or 60 should be used for roughing, while for finishing, elastic wheels of about grain No. 80 give the best results. Elastic wheels are almost always used for finishing, but they are too expensive compared with vitrified wheels to be used for the removal of the large amount of stock necessary in the roughing operation. An excellent finish is produced by the elastic wheel when only a few thousandths of an inch of stock is removed. Groove-grinding should be done wet and the wheels trued and dressed with a diamond.

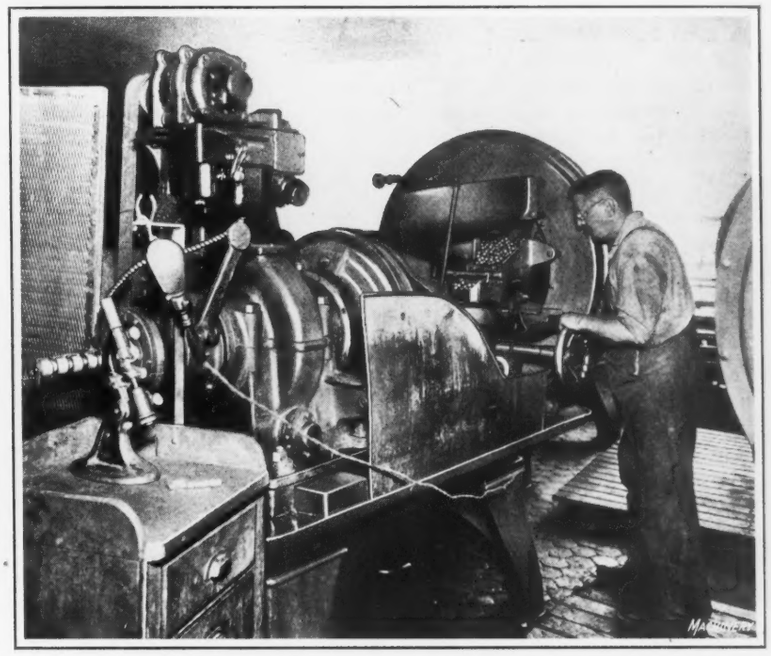


Fig. 5. Hoffman Machine which is used for finish-grinding Balls after the Roughing Operation

Grinding Inner Rings of Ball Bearings

Rough and finish surface grinding is done in exactly the same way as the corresponding operations on the outer rings, and the same types of machines are used.

The next operation on inner rings of ball bearings is that of bore grinding, which is an ordinary internal grinding operation, and may be performed on any standard internal grinding machine. A good finish is required, and this is secured by using wheels of No. 46, 50, or 60 grain.

The groove grinding can be done on the oscillating-head machine or on a small cylindrical grinding machine. The wheel face is formed with a diamond, and when a plain cylindrical machine is used the wheel is fed straight into the groove in the ring. With this type of machine, wheels of No. 46 grain are used for roughing and No. 80 or 100 grain for finishing. Generally both the roughing and finishing wheels are made by the vitrified process, although elastic wheels are sometimes used.

Great care must be exercised in grinding ball race grooves. Not only must the grooves be very accurately sized, but the



Fig. 6. Vertical-spindle Grinding Machine surface-grinding the Sides of Ball-bearing Rings

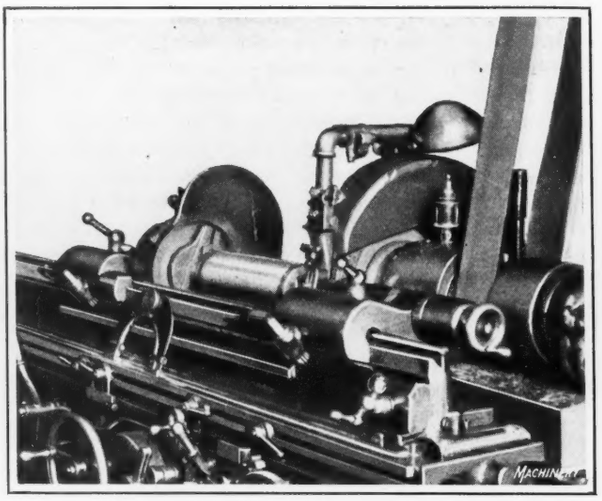


Fig. 7. Cylindrical Grinding Operation on the Outside of a Gang of Ball-bearing Rings

finish must be the best it is possible to obtain on a commercial basis. The life of a ball bearing depends as much on the character of the raceway as on the balls. The grinding must not overheat the surface of the raceway, on account of the resulting tendency to "skin soften" or produce minute cracks and checks in the surface, which would cause the bearing to fail after short service.

A Van Norman machine is shown in Fig. 9 grinding a double-row end-thrust ball-bearing plate. This plate is 14½ inches in diameter, and each groove is intended for balls two inches in diameter. The radial type of machine can also be applied to certain other classes of work in the automotive field. Two examples are shown in Figs. 10 and 11. The operation illustrated in Fig. 10 is that of grinding the outer radius on an automobile universal joint cover, and Fig. 11 shows a machine grinding the ball end of a steering knuckle.

Grinding Roller Bearing Cups

Grinding operations are employed in the making of three important parts of one type of roller bearing, namely, the cup, the cone and the rollers (Fig. 12). The cups, after being hardened and inspected, come to the first grinding operation about 0.008 inch over size. Approximately this amount of stock is left on all surfaces which are ground. The edge of the cup on the side having the opening of smaller diameter is first surface ground. This may be done on a machine of the universal type. The headstock is set at 90 degrees, and the piece is held on a magnetic chuck (the face of which is in a vertical plane) and the edge is ground on the face of a straight wheel, the operation being similar to surface grinding on a rotary surface grinding machine. This ground surface is then used as a reference surface during the next grinding operation. A Norton multi-purpose machine could be employed for this operation. A machine, such as the Heald automatic piston-ring grinder is also adapted for grinding the side or edges of bearing races, especially when the grinding is done on a large scale.

The next operation consists of grinding the taper bore, which constitutes the outer raceway of the bearing. A universal grinding machine is used, the work-head being swiveled to give the proper taper and a magnetic chuck for holding the work. A ring of non-magnetic material on the chuck is used to center the work. The taper bore is ground dry, this being the only dry grinding operation on the cup, and this ground surface is used as the reference surface for the grinding of the outside diameter.

The outer surfaces of roller bearing cups are finished by grinding on any plain cylindrical machine like the Norton type. A number of the cups are mounted on a special mandrel equipped with double tapered collars, each collar carrying two of the cups that are to be ground. The cups are placed on the mandrel with the tapers extending in opposite directions, and are held securely by being clamped between

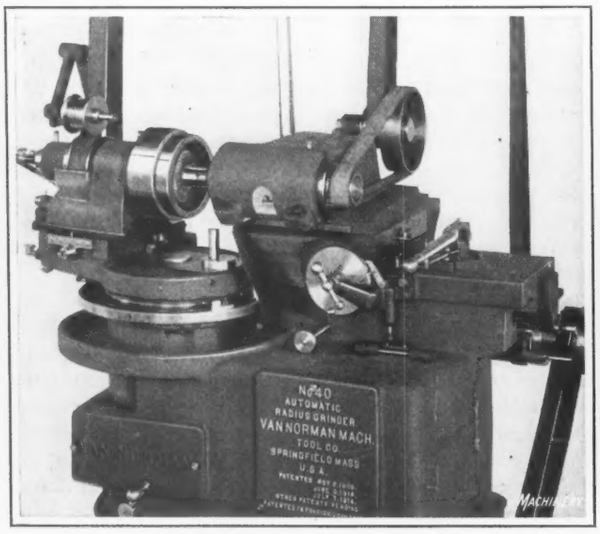


Fig. 8. Grinding the Raceway in an Outer Ring using an Automatic Radius Grinder

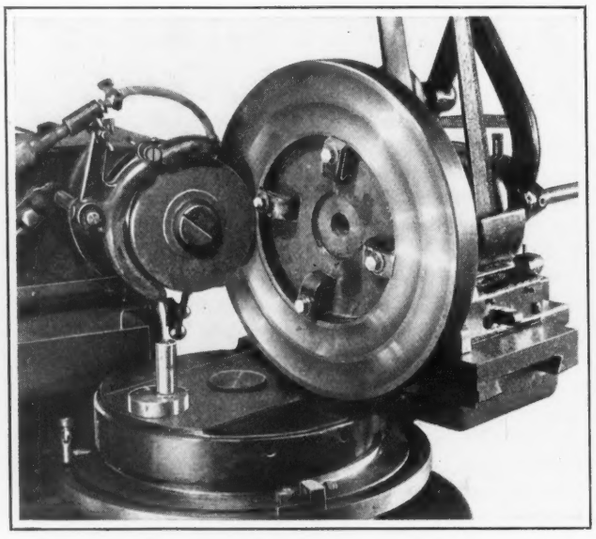


Fig. 9. Grinding a Double-row End-thrust Ball-bearing Plate on a Radius Grinder

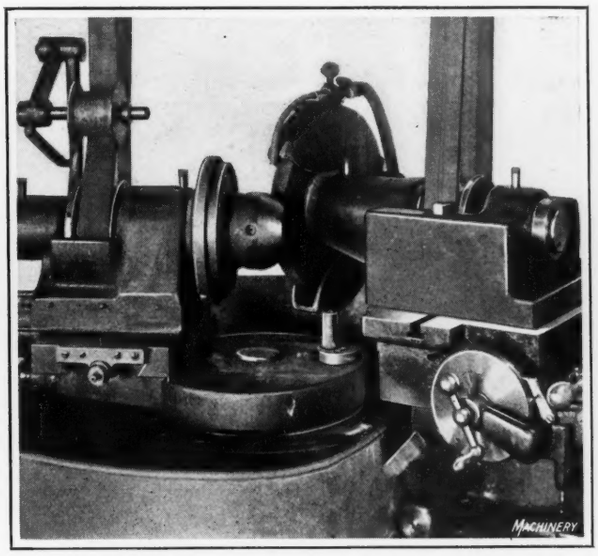


Fig. 10. Grinding the Outer Radius on a Universal Joint Cover



Fig. 11. Grinding the Ball End of a Steering Knuckle

a flange at one end and a ring at the other. While one "gang" of cups is being ground, another mandrel is being loaded.

Grinding Cone or Inner Raceway

The edge at the large end of the taper on the cone is ground first and used as a locating surface. The grinding is done wet on the same type of machine that is used for the first grinding operation on the cup.

Grinding the bore of the cone is a simple internal grinding operation performed on any well-constructed internal grinding machine. The bore is then used for locating the work on a mandrel while the tapered raceway is being ground. This is ground on a universal machine using an expanding mandrel to carry the cone. The work-head of the grinding machine is set at the desired angle and the grinding is done on the face of a straight wheel.

The last grinding operation on the cone is very important. The two shoulders *A* and *B* in Fig. 12 must be ground exactly parallel with each other and at the proper angle with the bearing surface, in order that the bearing may sustain a thrust load satisfactorily. The method by which this grinding operation is accomplished is to equip a universal grinding machine with two wheels of different diameters, and have the work-spindle of the machine set at an angle so that the two wheels may come in contact with the work simultaneously and grind the two shoulders. To facilitate the truing of the wheel, two diamonds are mounted in a holder secured to the work-spindle housing.

Grinding the Rollers

The only grinding operation on the rollers is that of grinding the bearing surface. This may be done on a Brown & Sharpe grinding machine equipped with a special magazine feed mechanism. The rollers are put in a feed chute, which brings them to a position to the right and in front of the grinding wheel face. A push-rod pushes an individual roller between two spring fingers, which then carry it forward to a position between the machine centers where it is automatically gripped and held in the proper position for grinding. After the roller is ground on the face of a straight wheel the tail center is withdrawn and the roller drops into a receiver. The tail center is then allowed to spring back into place, and as it does, it comes in contact with a new roller held in place by the spring fingers. This operation is entirely automatic except that it is necessary to feed the wheel in at intervals to compensate for wheel wear.

Another type of roller bearing contains only straight cylindrical parts. The grinding operations, although an important part of the manufacture, do not involve special features, as they are simply straight cylindrical and internal grinding processes performed in the same manner and with the same machines as work of a similar nature. Accuracy of grinding is essential.

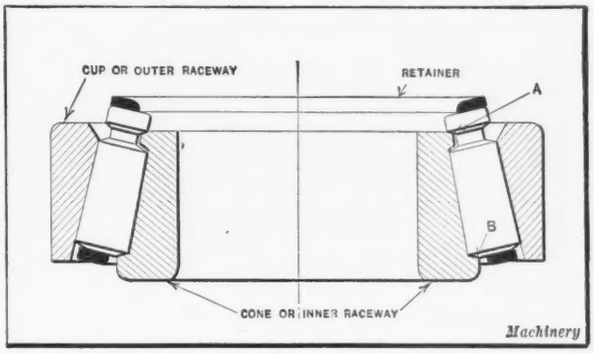


Fig. 12. One Type of Roller Bearing

* * *

THE SCARCITY OF PLATINUM

Platinum is used to a considerable extent in the industries, but the great advance in the price of this metal during recent year has had a retarding influence upon its industrial applications. The advance in price was due primarily to the use of platinum in the manufacture of war materials and to the scarcity of the metal, most of which in former years had come from Russia. As soon as the price increased, due to its scarcity, the metal was immediately diverted to a use for which it is really not adapted, namely, jewelry. There is no reason to doubt that the practice of setting precious stones in platinum has been adopted because of the high cost of the material. In 1920, 57 per cent of the platinum consumption of the United States was used in the jewelry trades, 19 per cent by the electrical industries, and 10 per cent by chemical works, while the remainder was distributed between dental uses and minor industries. While substitutes for many of the uses of platinum in the electrical industry have been found, it still plays an important part in this field. If through increased supply the price of platinum should again fall below that of gold, it is likely that it would cease to be used for jewelry, in which case the supply for industrial purposes would be all the greater.



Making Radio Parts

By FRED R. DANIELS

Methods Employed in Making Radio Head-phones at the Plant of the Newark Engineering & Tool Co., Newark, N. J.

THE purpose of head telephone receivers is to change the varying direct-current impulses of the receiving circuit to sound waves, and the principles of construction are the same as in ordinary telephone receivers. More care is required, however, in building a radio receiver than for the ordinary telephone.

The construction of the head-phone receiver will be understood by reference to Fig. 1. The parts are assembled into an aluminum case, and are covered by the diaphragm which is enclosed by a hard rubber cap. The most vital unit is the magnetic coil, of which there are two in each instrument. These coils are wound on insulated iron cores, such as shown at *A*. After winding, the coils have the appearance shown at *B*, the lower one of which is insulated, while the upper is not. The two coils are connected; the ends of the wires are attached to two brass screws located in a fiber terminal piece *C*. The arrangement is shown in the view of the assembled instrument.

The terminal piece is fastened into the case and contains two radial holes for plugging in the connection to the radio receiving apparatus. An electromagnetic force is set up whenever a coil of wire is wound around a soft iron core, so that in a receiver coil any variation in strength of the electrical impulses correspondingly affects the movement of the diaphragm. Consequently, louder or fainter tones are received according to the excitation in the magnetic coils. In addition to the magnetic force induced by the winding of the coils there are two permanent magnets *D* fastened into the case which cause an additional bellows movement of the diaphragm and serve to balance its action. The instruments are hung in a yoke *E* so that they are free to swivel and adjust themselves to the head. The end of the yoke stem has a suitable connection to the head band, the parts of this connection being shown at each side of the yoke.

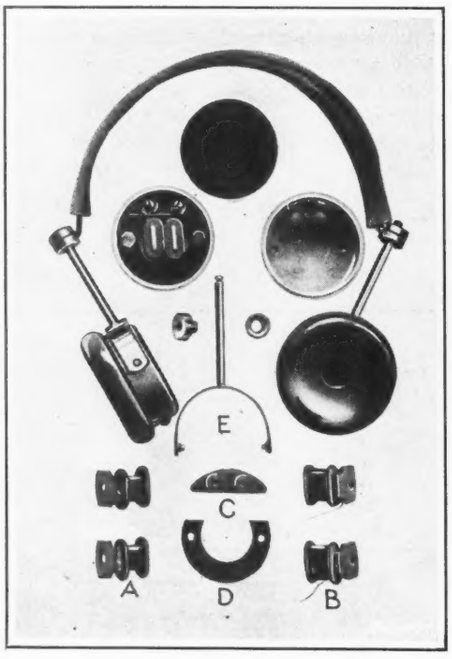


Fig. 1. Head-phones and Parts

Drawing and Threading the Case

In dealing with the manufacture of this instrument, as carried on by the Newark Engineering & Tool Co., Newark, N. J., only certain operations will be referred to. Attention will be focussed mainly on the making of the coils and the magnets. The aluminum cup which forms the case is made of sheet aluminum, 0.080 inch thick, and is drawn in two operations, the second of which is performed with the set-up illustrated in Fig. 2. The machine used is a double-action back-geared Bliss press, and the dies are of the push-through type. A shell produced in the first operation is shown in the die; it is held in place by the punch-holder while the punch passes through it and completes the shell.

After the holes have been punched in the cases, they are ready to be threaded for the hard rubber cap. The thread is produced by rolling, as illustrated in Fig. 3. Here a Rockford tool-room lathe is shown equipped with a thread-rolling tool and a chuck having two pins that engage the punched holes in the cases to drive them. The cases are supported at the end during the threading operation by a fiber collar which has a female center to receive the regular lathe center. There are twenty threads per inch rolled on the case, and the tools are kept clean by the frequent application of kerosene. The open ends of the cases are next shaved to length; this is also done on a Rockford lathe. The parts are finally polished, properly stamped, and delivered to the assembling department where they are assembled and packed for shipment.

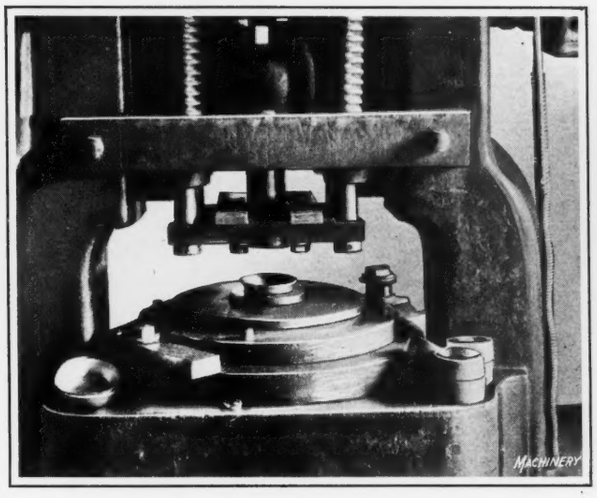


Fig. 2. Second Drawing Operation on the Aluminum Cases

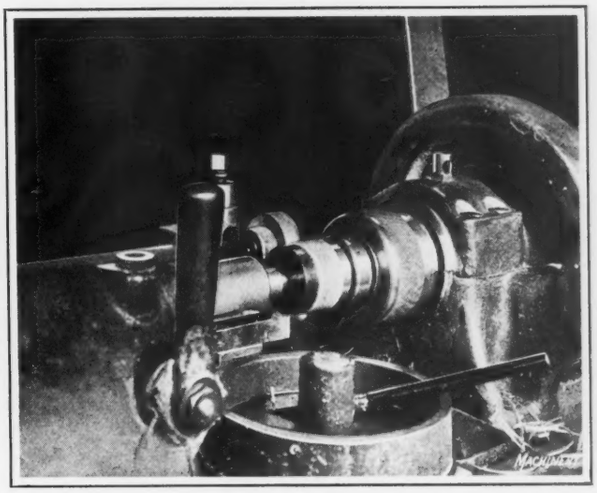


Fig. 3. Rolling the Threads on the Cases

Making the Magnetic Coils

The coils are the most important part of the telephone receiver, and careful workmanship is necessary in every phase of their manufacture. The cores are made from Norwegian iron, and are punched out and bent to a right angle, as shown at *A*, Fig. 1, on a power press. They are then fitted with fiber flanges, which are pressed on by means of a foot-press, the punch of which is slotted to pass over the end of the core. The operation of assembling the lower flange is illustrated in Fig. 5, which also shows a number of the fiber flanges and a box of iron cores to which the flanges are to be assembled. This operation is very simple, and is identical to that of assembling the upper flange. The section between the flanges is protected by insulating paper manufactured by the Irvington Varnish & Insulator Co., which is stuck on with shellac. After the coil has been wound it is also protected by insulating cloth, brushed with shellac.

Fig. 4 is a view showing one section of the winding department of the Newark Engineering & Tool Co. in which a number of special winding machines are employed to wind the coils. These machines were especially designed and constructed by George J. Zisch, president and general manager of this company, who is responsible for the designing and the manufacturing methods used in manufacturing the head-set.

The winding machines are driven by 1/50-horsepower induction motors which have proved the most efficient installation. The spindle which carries the core also drives a speedometer so that the exact number of turns may be obtained. No. 40 gage enameled magnetic wire is used, each core or spool containing approximately 4000 turns or about one-quarter mile of wire. It will be noted that these coils are placed in boxes on the bench. They are reconnected in pairs by a slightly coarser wire which furnishes the leads to the terminal connections of the instrument. Insulating the coils after winding completes their manufacture, and they are then sent to the assembling room.



Fig. 4. Section of the Coil Winding Department

Other Operations of Importance

The permanent magnets used in this telephone receiver are made of tungsten electric magnet steel, which is a very tough material; consequently, it has been found advantageous to punch out each magnet individually. The practice in this shop is first to cut out slabbed blanks from strip stock, 3/32 inch thick and 1½ inches wide, and next punch the two holes by means of which the magnets are fastened into the case. The final power press operation is punching out the center. The press work is performed on Zeh & Hahnemann single-action presses, the set-up for the final operation being shown in Fig. 6. The film of oil on the work makes it necessary to use a thin-edged pinch-bar to remove the work from the face of the die, but the dies themselves are of simple construction and need no special description. A quantity of finished magnet stampings is shown on the bolster plate of the press.

The hardening of the magnets preparatory to magnetizing is a very delicate operation, and great care must be taken not to apply too much heat; otherwise the steel cannot be properly magnetized. In magnetizing, which is the final operation, the magnetic plates are charged with a direct current of 110 volts, 12 amperes. The fiber terminal piece *C*, illustrated in Fig. 1, is punched from sheet stock, drilled and tapped for brass inserts which are pressed in place to accommodate the terminal screws for the magnetic coils.

Needless to say, all parts used in the construction of an



Fig. 5. Assembling the Fiber Flanges, using a Foot Press

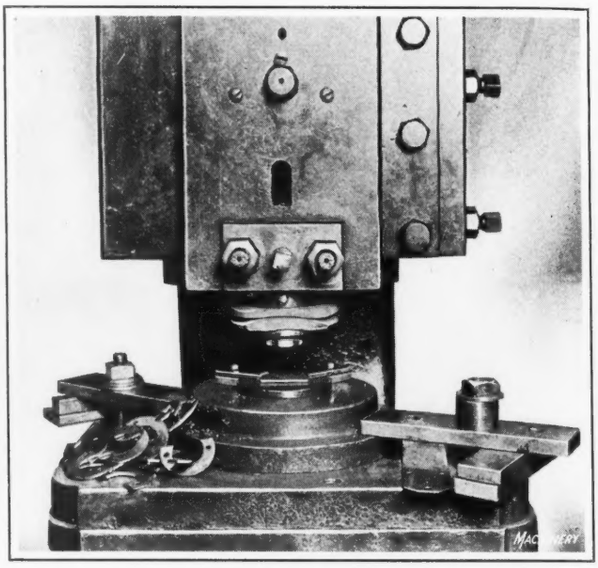


Fig 6. Press for punching out Centers of Permanent Magnets

instrument of this kind are carefully inspected before assembling, and the assembled product is given a final and searching inspection. Coil terminals are brazed to the terminal screws and the lead wires from the coils are insulated with tubing. The permanent magnets are fastened into the bottom of the case and care is exercised to prevent them from touching the magnetic coils. The assembled instruments are then tested for sound, each head-phone being connected to a tuning coil so that both phones of a set will be closely paired for sound.

* * *

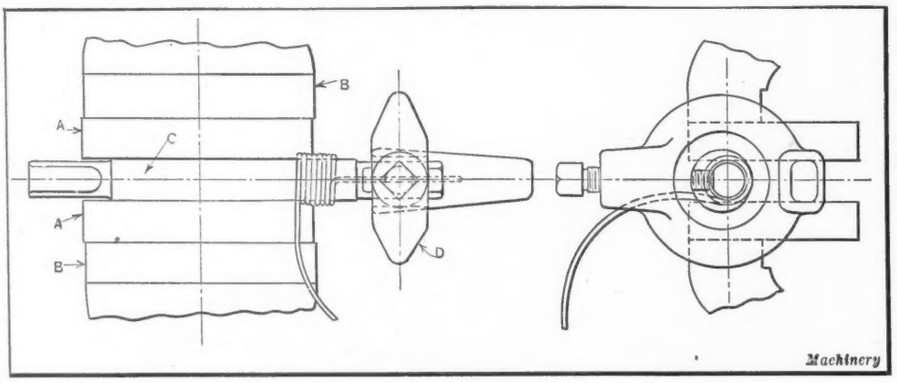
WINDING SMALL HELICAL SPRINGS

By A. A. FORSTER

The accompanying illustration shows a method of winding small helical springs which requires no equipment other than an ordinary bench vise, a suitable mandrel, a lathe dog, and two pieces of hard wood. The writer has found this method practical for making compression, tension, or twist helical springs from piano wire as large as No. 30 gage. In proceeding to wind a spring, the two hard wood blocks *A* are placed between vise jaws *B* as shown. The width of blocks *A* should be such that they will rest on the vise slide and come flush with the top of the jaws.

The bar or mandrel *C* must be selected to suit the size of spring required. A lathe dog *D* or a clamp is used to hold the spring wire to the end of the mandrel. To start winding after the wire has been clamped to the mandrel, first bend the wire so that it will be at an angle of 90 degrees with the mandrel at a point about ¾ inch from the lathe dog. With the spring wire held in the left hand in a vertical position and the lathe dog or clamp held so that the bend just made rests in a horizontal plane, the vise is closed so that the wire is forced into the wood.

The winding is now accomplished by turning the clamp or lathe dog, allowing the wire to follow the original indentation made in the wood. In winding tension and twist springs, the mandrel should be held nearly horizontal or parallel with the tops of the wood blocks, but to wind a compression spring the bar or mandrel should be held at an angle as determined by the pitch of the spring required.



Method of winding Small Helical Springs in a Vise

The approximate diameter of a mandrel required to give a certain diameter spring, using a wire of known gage, can be determined by referring to MACHINERY'S HANDBOOK, page 443. If tables are not available some idea of the size of mandrel required may be gained from the fact that in winding a spring from No. 36 gage wire it was found necessary to use a steel bar or mandrel about ½ inch smaller in diameter to obtain a spring having an outside diameter of ¾ inch. For smaller springs the mandrel must be proportionately smaller to obtain the required outside diameter.

* * *

GLASS-TOPPED DRAWING TABLE

By FRANK H. JONES

A handy table to have in any drafting-room can easily be made from an old, worn-out drawing-board placed on horses and covered all over with white paper. Around the two sides and back of the table thus covered, build up an enclosure by placing pieces of 2- by 4-inch planed stock, the 4-inch side upright, along the edges. Over the top place a piece of heavy glass which will cover the entire surface of the built-up area. This gives a plane glass surface covering a well four inches deep which is open on the front side.

A portable electric light cord with a hand lamp completes the outfit. The lamp cord should be long enough to allow the lamp to be moved anywhere under the glass. Such a table, once constructed, will be found indispensable in checking drawings and tracings. The part of the glass not in use should be kept covered with heavy paper or some dark material.

STANDARDIZATION OF TOLERANCES

While tolerances and allowances for machine parts must be related to the function of each part, it is of course practicable to standardize such data in so far as it applies to certain general classes of machine fits. This fact was emphasized in an editorial published in July, 1919, MACHINERY, page 1033, in which a reasonable degree of standardization for tolerances and allowances was advocated, the plan being to base the standards upon data which experience had proved to be satisfactory for different general classes of service.

Important work in connection with standardizing tolerances and allowances for machine fits is now being done by a sectional committee of the American Society of Mechanical Engineers. This "Committee on Plain Limit Gages for General Engineering Work" has as its chairman, Col. E. C. Peck, general superintendent of the Cleveland Twist Drill Co. At a meeting held July 17, the work previously done was discussed by the committee and certain changes suggested, the aim being to finally recommend standards for adoption by the society which will be based upon approved practice and which will be of considerable value to the machine-building industry in general.

These standards include eight classes of machine fits designated as: (1) loose fits; (2) free fits; (3) medium fits; (4) snug fits; (5) wringing fits; (6) tight fits; (7) medium force fits; (8) heavy force or shrink fits.

The loose fits allow considerable freedom and are intended for agricultural and mining machinery, controlling apparatus for marine works, textile, rubber, candy and bread machinery and general machinery of a similar grade, as well as some ordnance material.

The free fits provide for a liberal allowance and are for running fits with speeds of 600 revolutions per minute or over, and journal pressures of 600 pounds per square inch or over. Examples under this classification include certain parts of generators and engines, many machine tool parts and some automotive parts.

The medium fits are based upon a medium allowance and are for running fits under 600 revolutions per minute and with less than 600 pounds per square inch journal pressure. This class also includes sliding fits and the more accurate machine tool and automotive parts.

The snug fits have a small allowance and represent the closest fit which can be assembled by hand, requiring work of considerable precision. This class is used where no perceptible shake is permissible and where moving parts are not intended to move freely under load.

The wringing fits represent practically metal-to-metal contact, and the assembling is usually selective and not interchangeable.

The tight fits have a slight negative allowance and are more or less permanently set, light pressure being required to assemble. Examples include fixed ends of studs for gears, pulleys, rocker arms, etc., driving fits in thin sections or extremely long fits in other sections. This class is applied in automotive and ordnance work as well as in general machine manufacture. It may be used for shrinkage fits when the sections are very light.

The medium force fits require considerable pressure and are for permanent assembling. Applications include locomotive wheels, car wheels, armatures and the assembling of crank disks on their axles or shafts. This class also applies to shrinkage fits for medium sections or long fits.

The heavy force and shrinkage fits have considerable negative allowance and are applied where the metal will withstand considerable stress and where a heavy force fit is impracticable. Examples include locomotive tires and heavy crank disks of large engines.

THE BELGIAN MACHINE TOOL MARKET

Industrial conditions in Belgium are improved. There is no longer an immediate threat of German competition. Notwithstanding these favorable aspects, the Belgian market for American machine tools is not promising, because there is considerable American machinery in stock, probably aggregating 15,000,000 francs in value. It will no doubt require another year for the sale of these machines, even at the sacrifice prices at which they are being offered. Acting Commercial Attache S. H. Cross, of Brussels, states that American-made machine tools stand high in favor even at the prevailing higher prices. At the recent Commercial Fair this fact was shown to be true—one of the best known Belgian manufacturers is said to have sold no lathes whatever, while there were several purchases of American machine tools. Some universal milling machines as well as broaching and balancing machines were ordered from American manufacturers, which is an indication that the American prices are not prohibitive. The Belgian machine dealers, however, after having suffered considerable losses, cannot be expected to stock machinery again for some time to come.

German Competition in the Belgian Market

In view of constantly-increasing labor costs in Germany, the German manufacturer cannot produce a machine tool to order and deliver it in Belgium at a price much below the quotations of American machine tool builders. On the other hand, German machinery dealers who accumulated considerable machinery stocks before production costs in Germany had risen greatly, can still undersell American tools as long as such accumulated stocks hold out. A case of this kind is noted in which a well-known American radial drilling machine is quoted in Belgium at 13,500 francs, while a German machine, apparently a reproduction of the American tool, could be purchased in Germany a few months ago for 4000 francs. It is probable that at present this German machine at the factory would cost double this amount.

The position of the German manufacturer is exemplified by another instance: An American representative quoted a Belgian prospect 82,000 francs for a well-known make of American motor-driven lathe, with motor. The representative was told by this prospective customer that he could practically duplicate the machine for 40,000 francs by buying a German machine. The customer delayed placing the order in Germany; when he finally did so he was informed that the price had been advanced to 80,000 francs, without motor.

Future Outlook Encouraging

The outlook for American machine tool sales in Belgium appears, on the whole, to be more hopeful than it has been recently. Better results can probably be obtained in this market by supporting local representatives to the extent of supplying moderate stocks on consignment. The recent losses of the average Belgian firm have been too great to permit any purchases for stock. Orders for machinery for restoration purposes naturally have been concluded; however, some shop construction is reported in the vicinity of Brussels, and a certain amount of buying for replacement and development is being done. It is quite likely that moderate price reductions would somewhat increase the sale of American shop equipment in Belgium.

Efforts have been made recently to place agencies for small American electrically-driven woodworking machinery in Belgium. In view of the low wage rate of hand-labor and the small size and limited means of most Belgian woodworking shops, it is believed that the market for this equipment is very limited and would hardly compensate the cost of advertising necessary to place these products before the prospective customer.

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THE TREND OF MACHINE TOOL PRICES

During the last eighteen months machine tool prices have tended steadily downward, but there are signs which indicate that the low level has been reached and that from now on the trend will be upward. A few machine tool builders have already increased their prices in view of the conditions in the material and labor markets, and others are contemplating a readjustment in prices within a few months.

When prices were reduced to the present level, materials had come down to a point from which they have since considerably risen; also there was a general belief that wages would come down to a much lower level than they have, and on the strength of this, manufacturers reduced their prices below replacement costs. Now, with an increasing demand, it becomes necessary to replenish the stocks at costs higher than were anticipated. Pig iron, castings, and steel are higher than at the beginning of the year. The hourly rates for labor have not been materially reduced, and with the scarcity of skilled mechanics in the machine-tool building field, there is no reason to expect lower labor costs.

Doubtless the expectation of increased machine tool prices is the reason why many large corporations have placed substantial orders during the past two months. They realize that the present is the best time to buy not only because prices are at their lowest but because deliveries are prompt. Unmistakable indications of rising prices usually result in a rush of orders which in turn slows down deliveries.

* * *

TRADE ASSOCIATION ACTIVITIES

The activities of a number of associations, most of them in the building trades, formed for the purpose of maintaining prices of material and labor at fictitious levels, have created in the minds of many people the erroneous belief that trade associations as such are harmful to the public welfare. Secretary Hoover has stated, and investigations have shown, that not one-tenth of the many hundreds of manufacturers associations in the United States have engaged in any activities that could be construed as an infringement of the law. Trade associations may and should engage in many activities that are of benefit to the public interest as well as to their own members; because by decreasing the costs and hazards of conducting business, prices usually are reduced. Many such associations are actually working toward a reduction of prices to the public. Secretary Hoover is particularly emphatic in his statements that trade associations as a whole are useful, and that violations of the law by a few associations does not condemn the lawful and useful activities of the others.

Among the many useful activities in which trade associations may and should engage, are the adoption of standard forms of contracts; collection of credit information; standardization of machinery and processes; adoption of uniform trade practices and methods; promotion of the education of apprentices; employes' welfare work; cooperation to oppose unfair legislation; promotion of closer relations with the Department of Commerce; collection of statistics of production, costs, consumption, and distribution; and the publication of such statistics for the benefit of their members and the public.

Some of the activities in which trade associations may not engage are agreements to increase or maintain prices, and to curtail production or suppress competition. Neither may they adopt any marks or labels which would tend to result in the same price being charged for articles made by different manufacturers bearing identical labels. The collection of credit information is permissible; provided it is not for the purpose of establishing black-lists.

As practically every manufacturer, in whatever line engaged, is now a member of one or more trade associations, manufacturers generally are interested in knowing what trade association activities are legal and are encouraged by the Government, and what are not permitted.

* * *

UTILIZE YOUR SPARE TIME NOW

While manufacturers are taking advantage of the industrial depression to improve their plants, working men should prepare for increased activity. Many thousands of workers have more spare time than they know what to do with, and those who give thought to their future will devote this time to practical study of the work they wish to engage in so that when the door of opportunity opens they will be ready and qualified to enter. It is not necessary to attend school to accomplish this. There is an abundance of literature available on all phases of shop practice, and each man can be his own instructor.

Now is the time for every working man to take stock of his knowledge and to see what lack may bar his future progress. He should ask himself, "Do I know all there is to know about my job?" "Do I know what feeds and speeds should be used on different classes of work?" "Do I know what lubricants to use for different materials?" "Do I know what factors govern production and whether this design of die or jig is the most efficient for this particular work?" The answers to all these questions and many others are available in the technical literature of today and men can obtain the books needed with little expenditure. Even if that is not feasible for a man out of employment, he can always resort to the public library. The important objective is to form the habit of reading and studying, now that there is time.

* * *

BALL BEARINGS FOR TEXTILE MACHINERY

There are many opportunities for the economical use of ball bearings in textile machinery, and in several textile mills they have been provided to replace the plain bearings furnished by the builders of the machinery. In one instance several hundred ball bearings were so installed by one of the leading textile manufacturers.

The users of textile machinery would be better served if these bearings were made part of the original equipment by the manufacturer. Ball bearings are of as great value in textile machinery as in any other line of industrial equipment which requires bearings, and their use would often avert bearing trouble while effecting a considerable saving in power.

Textile machinery has been developed to a high state of efficiency by following the somewhat conservative principles of old-time mechanics; but some of the modern developments in machine construction could now be applied advantageously.

Cutting Prices Below Cost

By A. W. HENN, President, National Acme Co., Cleveland, Ohio

IN a period of depression such as we have just passed through and out of which we are now emerging, reductions in prices are naturally the order of the day, partly because labor and material costs in such times are generally reduced to a considerable extent, and partly because the law of supply and demand forces prices down. At first there is an attempt to keep prices at a level where a fair profit may still be realized, but after a while competition generally forces them down to a level where there are not only no profits but where goods are actually sold below cost.

At first sight it may seem uneconomical and unwise to sell the products of industry below cost at any time but there are reasons why it may be advisable to do so under certain circumstances; and there is generally a period during every depression when the need for selling below cost arises. The demand may be so small and competition so keen that if one or more manufacturers in a given field refused to accept conditions as they are, they would get scarcely any share whatever of the small business that is to be had. This, in turn, would make it necessary for them either to close their factories entirely and permit their organizations to go to pieces, or to carry a certain part of the plants along working on stock; this is not only expensive for the time being but sometimes may be followed by losses as great as would be the selling of the product immediately at a price lower than its actual cost.

During the present depression many manufacturers have concluded that it would be better for them to maintain their organizations as nearly intact as possible, even though this could be done only by selling at a loss. This has also made it impossible to hire more men, at least on a part-time basis, and to prevent too serious effects from unemployment.

Need for Selling below Cost is now Past

That period of the depression when it was necessary to accept practically whatever price the market would bring has now passed, and it is time to stop the practice of selling without regard to production costs. The demand in almost every line of metal products is now sufficient to warrant increases in prices to a level commensurate with costs, and manufacturers in general ought to recognize this fact. A prolonged period of selling below cost after the most acute stage of the depression has passed is injurious not only to the individual manufacturer but to the industry as a whole, because it deters the return to normal economic and industrial conditions. The shop or industry that continues to sell below cost naturally forces its competitors to follow a somewhat similar procedure, and as long as any industry disposes of its products thus, its economic condition is such that it cannot itself be in the market for the products of other industries, except to the extent of the bare materials that are used in production. On the other hand, as prices return to normal, and fair returns are realized on capital investment, the manufacturers themselves come into the market for new and improved equipment, thus aiding the early revival of industrial conditions in the entire field.

The demand at the present time for practically all of the products of the metal-working industries is brisk enough so that prices must rise. In some industries this increase in prices has already taken place, while in other branches it has yet to come; but in every case it is safe to say that the low level either has been reached and passed, or it has been reached and will soon be passed. Business is coming back much faster than one might have expected a few months ago, and unless some deterring influences are again brought into action—like nation-wide strikes that affect the supply of raw materials or transportation—there is every reason to believe that steady improvement is ahead, and that the return to normal conditions is assured. In some branches of the industry it may take somewhat longer to come back to normal than it will in others. The automobile industry may be said to have returned to a normal state already, and so have the industries depending upon it, such as the alloy-steel and the parts manufacturing lines.

Future Prices must be Higher than the Pre-war Level

Prices in finding a level which will cover costs and leave a satisfactory return on capital investment, must today unquestionably be a certain percentage higher than pre-war prices in every line of manufactured goods, because wages are definitely on a higher plane; and there is no reason to expect that wages will soon return to the pre-war level. Broadly considered, there is no reason why business should not be as stable and normal with a higher wage level and correspondingly higher prices as it was previous to the war. The only thing that is required is such an *equalization of wages* that labor in different industrial activities and in various trades will receive approximately the same compensation for similar work.

Equalization of Wages Necessary

It is impossible to continue to pay some trades wages that are two or three time as high as the wages in other trades. It is true that in those trades where steady employment throughout every day in the year is impossible, hourly wages should be correspondingly higher than in those where permanent employment is reasonably assured; but the adjustment should be equitable and proportionate to the reasonable period of employment. The workers in the transportation field particularly, who are assured of a permanency of employment equalled in few other occupations, are receiving proportionately higher wages than the employes in practically any other enterprise. Nevertheless, these men are more actively resisting a readjustment of their wage scales than the members of any other craft or trade; but an equalization of wages will nevertheless become necessary even if industry must pay the price of cessation of activity and unemployment due to strikes and labor troubles.

There is one thing that the labor unions must learn sooner or later—and the sooner they learn it the better it will be for their own well being and prosperity—and that is that you cannot get any more out of an industry than you put into it. If you put into an industry short working hours and inefficiency due to unreasonable rules and regulations, that industry in the long run will suffer and the fund out of which the workers must be compensated will be tha* much less. If we were all working at all times at the top speed that the piece workers did in the munitions factories during the war, the production that could be shared by all would be that much greater and the possibility for greater returns for labor would increase. It is when the cost of production begins to exceed the price at which the goods can be sold that the wheels of industry stop; if the cost of production could be continuously held below the price that the consuming public is willing and able to pay, the wheels of industry would continue to turn without interruption.

Diamond Alloy—A New Cutting Metal

DIAMOND alloy is a non-ferrous alloy composed mainly of chromium, molybdenum, and tungsten combined in proportions and by processes that result in a metal so hard that cutting tools made from it possess an unusual resistance against wear. Another favorable property is that tools made from the alloy may be used under conditions of feed and speed that raise the temperature almost to the fusion point without there being any tendency of the cutting edge to soften. The metal is non-magnetic, a property that is desirable under certain conditions.

The alloy cannot be forged, but milling cutters, slitting saws, reamers and other tools of this general character are cast in permanent molds, the process assuring a uniform composition of the metal and freedom from blow-holes and other defects sometimes found in cast metals. Some tools are cast on a steel core or center, or on a shank, while others are made entirely from the alloy. The possibility of casting on steel is especially important with such tools as keyway milling cutters where it is desirable to have the cutter at the end of a shank. In such cases the shank is made of chrome-vanadium steel which possesses ample strength to withstand severe service conditions. A flange on the end of the shank has a groove machined around its periphery, and when the alloy is cast on this flange, the groove serves to positively lock the metal against sidewise movement. The same general form of construction is employed in making other milling cutters, slitting saws, chucking reamers, etc., advantage being taken in every case of using a lower priced material of ample strength for the shank.

A group of tools made from the alloy is shown in Fig. 1. A keyway milling cutter and shank of the design mentioned in the foregoing are illustrated at *A*, and a shell end-mill at *B*. The blades presented at *C* are for an inserted-tooth milling cutter, and that at *D*, for an inserted-tooth circular saw. A blade blank is shown at *E*. At *F* are illustrated a slitting saw and a solid Diamond alloy blank from which this tool is made. The milling cutters at *G* and *H* are machined from blank *I* on which the alloy is cast on a steel center. The chucking reamer at *J* has the alloy cast on a shank, and spot-facer *K* consists of a Diamond alloy cutter and a separate steel shank on which the cutter is screwed.

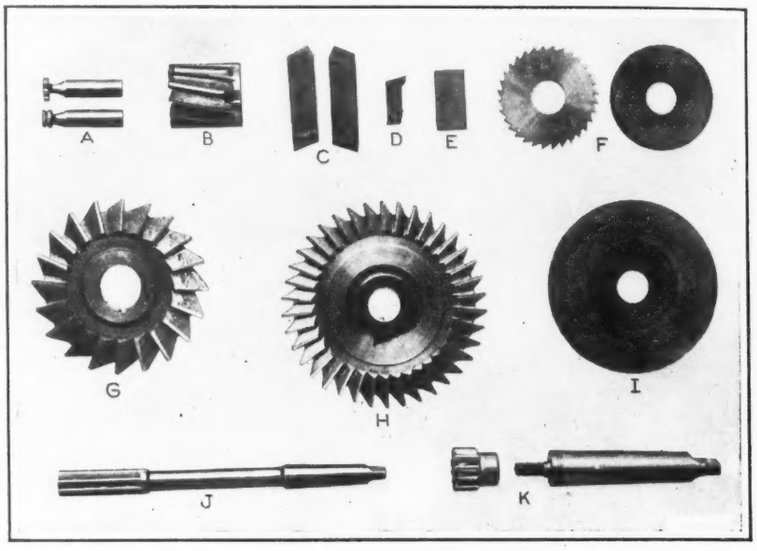


Fig. 1. Typical Examples of Tool Bits and Cutting Tools made from Diamond Alloy

Advantage is also taken of the possibility of welding Diamond alloy to steel by making "laminated" tool bits which consist of a strip of the alloy welded to a strip of chrome-vanadium steel. Such a combination provides a tool having both the cutting properties of Diamond alloy and the strength possessed by the steel backing. Laminated tool bits are shown in Fig. 2 at *P*, and tool bits made entirely from the alloy, at *Q*.

The following examples of results obtained with tools made with Diamond alloy will be of interest: In milling cast iron the cutter was run at a speed of 370 feet per minute with a feed of 15 inches per minute and a ⅛-inch depth of cut. In turning machine steel having a carbon content of from 0.35 to 0.40 per cent, the tool was operated at a cutting speed of 125 feet per minute with a feed of 5/16 inch per revolution of the work and a ⅛-inch depth of cut. In turning a chrome-nickel steel shaft, the cutting speed was 125 feet per minute with a feed of 1/32 inch per revolution of the work, and a 7/32-inch depth of cut.

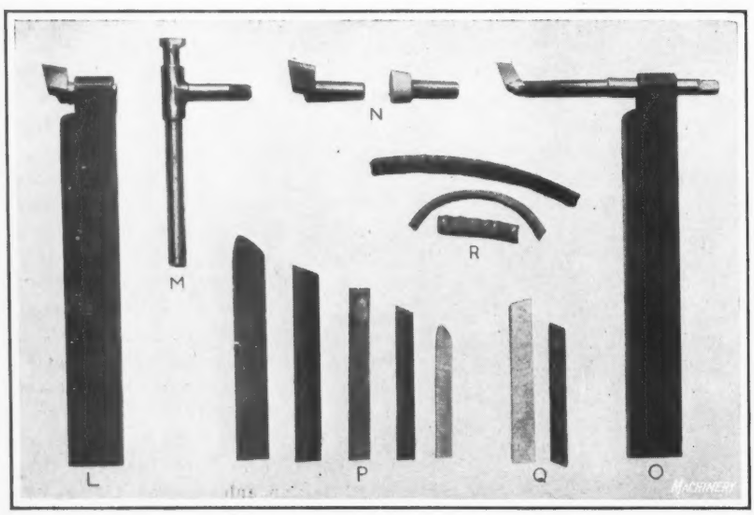


Fig. 2. "Super" Tool-holder and Tool Bits and Diamond Laminated and Solid Tool Bits

Referring to Fig. 2 there will be seen at each end of the illustration a tool-holder known by the makers as the "Super." This tool-holder is intended for use with different styles of cutter bits made from the alloy. It is made in nine sizes with shanks ranging in cross-section from ⅜ by ¾ inch up to 1¼ by 2½ inches. The boring tool *M* and the single-point and round-nose cutter bits *N* have a taper shank which fits into a corresponding socket in the tool-holder. In the case of a single-point bit the same bit and holder can be adapted for service where either a right-hand, straight, or left-hand tool is required, by changing the position of the bit in the holder.

The taper of the shank on the tool bits is

very gradual, and as a result the pressure of the cut forces the shank securely into the holder and assures permanence of the bit position without the use of set-screws or other clamping means. This tool-holder can also be furnished for drills, boring tools, etc. Diamond alloy and the "Super" tool-holder are manufactured by the Kent-Owens Machine Co., Toledo, Ohio, and the exclusive selling agent for these products is P. H. Biggs, 1235 W. 9th St., Cleveland, Ohio. The alloy was formerly made by the Diamond Alloy Tool Co., St. Louis, Mo.; it was developed by Walter Brown, who is now manager of the Diamond Alloy Division of the Kent-Owens Machine Co.

* * *

STOP FOR AN AUTOMATIC MACHINE

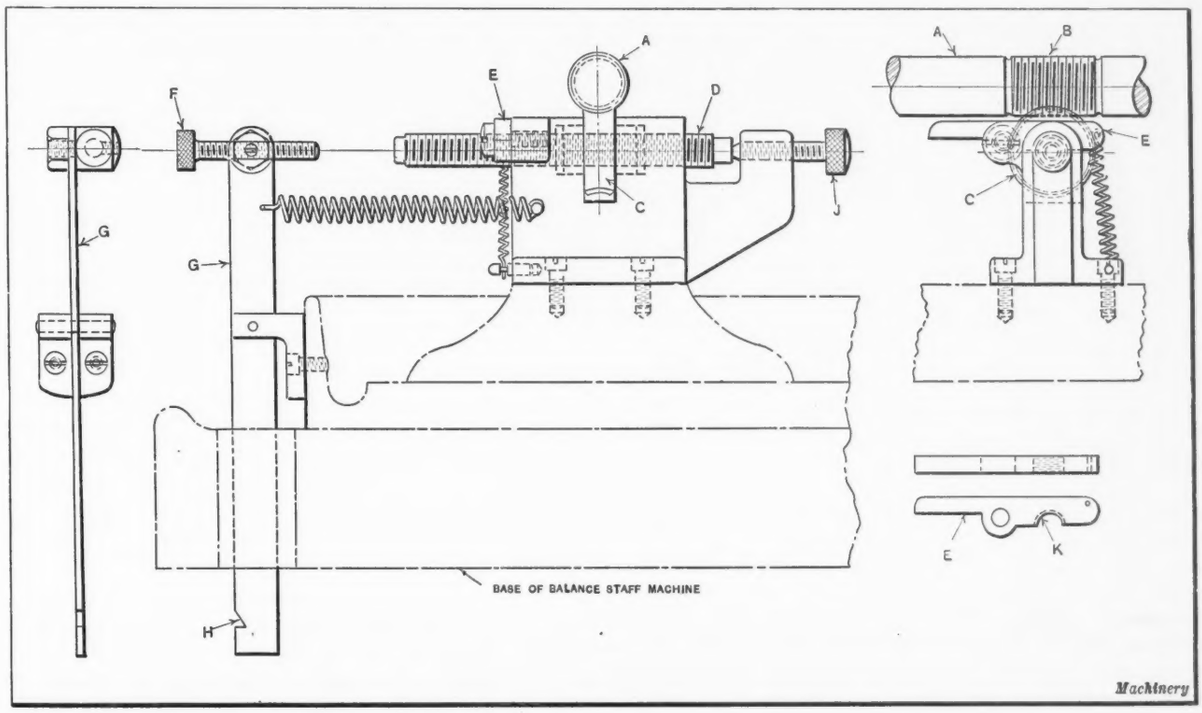
By I. BERNARD BLACK

An automatic stop designed to prevent the jamming of stock in the feeding chuck of a balance-staff machine when the end of the stock has been reached is shown in the accompanying illustration. Several automatic stops were tried out on these machines without success previous to the development of the stop shown. This stop is a modification of the type used on bench screw machines. Before proceeding with the description of the stop it may be well to mention that a balance-staff machine is used for turning the balance staffs for watches. The balance staff is the shaft on which the balance wheel of a watch is secured. At each end of this shaft is a fine pivot. When assembled in the watch these pivots are supported by jewel bearings.

The balance-staff machine is similar in design to a small bench screw machine. It consists of a spindle containing a chuck and a mechanism for feeding the stock forward, a camshaft with a set of cams for operating the chucking mechanism, for reversing and controlling the feed, and for operating the front and rear cross-slides. The front cross-slide carries the cutting-off milling cutter, and the rear cross-slide the milling cutters that form the pivots. It might be added that the balance staff is only rough-milled in this machine; it is afterward put into a pivot-turning machine and the pivots turned down to the required diameter and then polished. During the milling of the pivots and the cutting-off operation, the work is firmly held in a support. The spindle camshaft and the cutters in the cross-slides are all driven separately from the main driving shaft.

In attaching the stop it was necessary to alter the regular camshaft *A* somewhat. A left-hand quadruple-thread worm having five threads per inch with a lead of 0.20 inch and a pitch of 0.050 inch was cut on the shaft at *B*. This worm is employed to drive the worm-gear *C*. When the machine is in operation the camshaft turns the worm-gear *C* which, in turn, revolves shaft *D*. A keyway is cut the entire length of the threaded part of shaft *D*. A key held in worm-gear *C* is made a sliding fit in this keyway. Now as shaft *D* has a left-hand thread which fits the threaded part *K* of piece *E* (see view in lower right-hand corner), shaft *D* will move toward the set-screw *F* when the machine is in operation. When lever *G* is pushed back by the end of shaft *D* coming in contact with screw *F*, the stopping device of the machine, which is controlled by a latch held in V-slot *H*, is released and the machine stopped.

The stock used in the manufacture of the balance staffs comes in three-foot lengths, and the stopping device is set to stop the machine automatically when about 2 inches of stock is left in the feeding chuck. This prevents the jamming of the stock between the cutters and enables the operator to easily take out the piece left in the chuck and to feed in a new piece of stock by lifting part *E* sufficiently to disengage the thread of shaft *D*. The latter member may be pushed back into contact with the stop-screw *J*, when lever *G* will spring back to its former position as shown in the illustration. The machine is then started by lifting up the starting latch so that it will be engaged by the V-slot *H*.



Device for automatically stopping the Operation of a Balance-staff Machine when the End of the Stock is reached

* * *

The Bureau of Fire Underwriters has estimated that the destruction of property by fire in the United States during the five-year period ended with 1920 was $1,672,722,697. Carelessness in the use of matches is said to be the cause of property loss valued at $90,000 000. Spontaneous combustion, lightning, heating systems, sparks on roofs, and defective chimneys are other causes of fire loss named by the bureau. It is safe to say that the fire loss would have been greatly reduced had every property owner given the various causes named above due consideration and taken steps to remove all unnecessary hazards.

Advancement in the Machine Industries

By LUTHER D. BURLINGAME, Industrial Superintendent, Brown & Sharpe Mfg. Co., Providence, R. I.

THE worthwhile opportunities in the machine tool industry which should stimulate young men of ability to train in this field for their life work, have been well pointed out by Fred A. Geier and J. B. Doan in July MACHINERY. It is the purpose of this article to indicate some of the qualifications necessary to take advantage of these opportunities, and the preparatory steps required to make such a career successful.

When the writer entered the machine tool industry nearly forty years ago, he heard many expressions of discouragement from those already engaged in it—expressions to the effect that the "good old days" had gone, that there was no opportunity for men to advance, that there was nothing left for them but drudgery, and that they would advise their sons to go into other lines of work. Notwithstanding these pessimists (whom by the way we still have with us), there has been more progress during these forty years, and wider opportunities have opened up than in all the centuries before; and there is no reason to believe that the next forty years will not show equal and even greater opportunities, and opportunities along more specialized lines, so that each branch of training and of ability can have full scope. Those who are willing to train themselves now, will reap a rich harvest in the future.

Character

No matter what branch of the work is undertaken, there are certain qualifications essential to real success. The first of these is character. Many years ago the late Frederick W. Taylor said in speaking of the qualifications necessary to attain success in life: "Without the slightest question, character comes first, good sense second, and intellectual training third."

The training required to develop character and good sense is more difficult to define in a specific way than that of intellectual training. The former includes the cultivation of a spirit of loyalty, both to superiors and to the business with which one is connected; honesty in its broader sense, which might include faithfulness, promptness, thoroughness, etc.; and energy to prosecute the work in hand. It develops such qualities as are summed up in Hubbard's immortal "A Message to Garcia."

Character is not formed by studying rules in books, but is gradually developed by holding to a high standard through the many temptations in life, emulating the example of great men among contemporaries and acquaintances as well as characters in history and fiction. A man is fortunate indeed who through birth and home training starts his life work with a well-grounded character.

Good Sense

Under good sense might be placed the cultivation of judgment, which in turn can be acquired by learning from the mistakes of others, as well as one's own; by storing up a fund of information with which to measure new conditions as they arise; and by never depending on opinions without checking them up with facts. Intellectual training, through continued and extensive study, can be made an important adjunct to good sense because it gives, in addition to a broad knowledge, the ability to secure desired information quickly even though not carried in the mind. A trained mind that has learned to memorize, to analyze, and to coordinate knowledge, is a tool capable of being used in any emergency or for solving unexpected problems.

Speed and Accuracy

Every employer appreciates speed and accuracy in work, speed being a quality which counts directly in determining the value of designers, engineers, and executives, but which without accuracy may have its advantages entirely offset. Waste from inaccuracy is forcibly pointed out in a little booklet by Jerry McQuade, in which he cleverly shows how what seemed like a small error took the time of thirty-seven men, three women, two boys, and eight horses to correct.

Speaking and Writing

An important stepping-stone toward success lies in cultivating the power to speak and write convincingly. Whether speaking in public or in private, the ability to present forcibly before one or more hearers the reasons for pursuing a certain policy, or for accepting a proposed design, may mean success or failure. The faculty of stating clearly and briefly in a written report what it is desired to impress on others may lead to the acceptance of a plan or the adoption of a policy which, with poor presentation, would not be favorably considered even though good in itself.

The development of this ability can be helped by taking part in the activities of engineering societies, or such other societies as most directly deal with the particular phase of industry for which one is studying. This also can lead to a wide acquaintance, both personal and by correspondence, which is one of the best assets to insure future advancement. Many a young engineer has started on the road toward a wider field of activity by writing for the technical press, and by studying technical books and journals.

The Good Job is the Hard Job

The young man who is looking for an easy job is not likely to be the one who will excel later. It has been well said that "the good job is the hard job." Dr. Taylor, already quoted, says that in examining the careers of those men who have become successful: "It has been found that they are men of singleness and earnestness of purpose; men who have acquired by long training those habits both mental and physical which make them masters over themselves together with a firm determination to pay the price for success in hard work and self-denial."

The ability to serve well is the first qualification for success in directing others. One of the important lessons to learn is that of working with all kinds of people, both as superiors, as shopmates, and as subordinates. The cultivation of such traits as will make a man universally liked and respected by those about him, will prove a valuable possession in the successful handling of men.

Specialized Training

When the specific question is asked: "What shall I study to secure advancement in the machine tool industry?" it at once raises the question as to the definite line for which one is training. In addition to the general qualifications already discussed, the development of which should help in any branch of the work, there are many opportunities to specialize in training. For instance, there is the case of a boy brought up on a farm, with meager education, who

when he became an apprentice in a machine shop, spent his evenings studying algebra and geometry. He afterward became eminent as an authority on gearing. Then there is another case of a young man who spent his spare time outside the machine shop studying French and German. He afterward represented his employers at a great exposition abroad and later became sales manager for a company having extensive foreign connections.

Many young men of an inventive turn of mind received much stimulus a generation ago from a series of articles on the Cultivation of the Inventive Faculty, giving problems in mechanisms to be worked out by the reader. One, when asked what studies he expected to pursue during the summer, said that he felt that he would gain the most by studying human nature.

These illustrations show the wide scope of training which may fit one for advancement. Such training might be classified under the heading of the Five M's: Men, Methods, Material, Machinery, and Money, which, generally speaking, constitute the factors in industry.

Men—Learning to deal with the human element, with equal emphasis on the need of learning how to work with the boss and with the workman. This may also include all branches of industrial service work, such as safety, medical supervision, industrial schools, recreation, and Americanization. The ability to meet and deal with men is an important, if not the most important, element of salesmanship.

Methods—The study of shop organization, with its many branches, such as efficiency, routing, etc. Also economical methods of production and elimination of waste.

Material—Raw material; stock to be carried; its cost; its quality, including questions of hardening, heat-treatment, etc., the utilization of scrap; all are subjects worthy of serious study.

Machinery—Cultivating ingenuity and invention; learning simplicity and adaptability of design; tool and jig work, etc.; acquiring a knowledge of the history of mechanical development, including the matter of patents; and competitors' products.

Money—Acquiring proficiency in timekeeping, cost accounting, auditing, credit rating, and general office and business administration.

The Value of Having a Hobby

Besides the study given to the particular line chosen, every man should have a hobby, something that will take his mind entirely off his work. It is not always advisable to devote every minute of one's spare time to studies, even though good in themselves. Some time should be given to activities which tend to widen the circle of vision outside of the professional field. Having a hobby has directly to do with health, because any interest enjoyed as an avocation is conducive to good health. It goes without saying that without a healthy body and a clear mind one is working under a great handicap, which limits success in any line of endeavor.

Any of the various branches of mechanical industry here discussed, successfully mastered, can be made an effective tool for advancement to a position of trust and profit. While study and preparation should not stop with school but be made a part of lifetime activities, it must not be forgotten that the main purpose in life is not to absorb knowledge but to give it out. Success is not attained until a point is reached where instead of assimilating, knowledge is distributed for the benefit and advancement of industry, and the good of the community.

The lines of study here mentioned are merely illustrative. Other lines will be suggested by simply having the requirements stated; and it must be understood that broad and extended experience, in addition to knowledge acquired by study, is the sure foundation on which success in the machine tool industry can be built.

LEARNING VERSUS STUDYING

By A. W. FORBES, Forbes & Myers, Worcester, Mass.

On page 870 of the July MACHINERY is found the statement: "There is much less inclination to devote spare time to study than in the years preceding the war, and the tendency to avoid serious effort is marked." This statement is made about the "younger generation" which probably means those under, say, twenty-five years of age.

It may look that way to manufacturers who are trying to get their younger employes to study for advancement in their work, but a glance at the schools for people of working age gives an entirely different impression. At least in Worcester, school attendance has increased in an astonishing manner, both day and evening. New public and private schools are continually being opened, and the old ones are overcrowded. Does this show a disinclination to study? It would be hard to convince the unprejudiced observer that it does, and yet there is something in the statement quoted. This enthusiasm for schools is rather a desire to be taught than a desire to study. There certainly has been a change in the general attitude, but this change has been more a loss of self-control than a loss of ambition. The modern youth is ready to rely on others to make him into somebody rather than to direct his own course. It must be remembered also that the schools are continually diverting an increasing number of boys from the factories, and that those so diverted are often the ones most inclined to study.

Educators feel that this change is a great improvement. They point with pride to the growing number seeking school education, and are doing all they can to promote the good work. The author is inclined to take the opposite view. The electrical shop of Forbes & Myers, Worcester, Mass., employs a number of boys. Practically all these boys have spent a considerable portion of their spare time in some form of school study, academic, trade, or technical; day, night, or correspondence. While some of this study is doubtless valuable for general culture, particularly the academic, it seems to have no practical value for making progress in the shop.

The kind of study that the boys in the shop are urged to do is the kind that it is most difficult to get them to do; namely, to take up a problem which occurs in connection with the work, and to study it thoroughly, both in books and periodicals, or any other place where they can find information. It was probably this lack of personal effort on the part of the younger generation in the matter of study that was felt by the author of the statement quoted in the first paragraph of this article. Only by such study, however, can the shop employe advance beyond the knowledge that any of the standard courses can give him.

The cause of the changed attitude toward study can most likely be found in the schools. It is not a change that occurred during the war, although the war may have accelerated it. It has been going on for many years. From the kindergarten up the boys must fit into the school routine. At the same time they are being impressed with the value of the school. After a certain amount of study the mind naturally becomes tired, at least to the extent of not looking for problems to solve. With the propoganda urging them toward school study, the boys devote to it practically all the time that they are willing to give to acquiring any kind of knowledge; after that they cannot be expected to start right in again studying their work.

There seems to be actual conflict between the schools and real study that leads to advancement, but this point is not often recognized. A boy whose mind has been thoroughly trained to receive information in the way it is presented in school, is not so well prepared to study by himself as he would be if he had never been to school. Instead of blaming the boy, it might be more just to blame the institution that has failed to teach him the most profitable form of study.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, July 14

THE interruptions of the last three months have naturally deranged all branches of engineering industry and some time must elapse before production programs can be straightened out. There has, however, been a grain of comfort in the fact that, serious as the stoppage has been, it might have been disastrous had it not occurred during a period of very limited buying.

In the machine tool trade makers are finding that current demand is confined largely to special machines. Inquiries for standard machines continue and it is generally expected that export trade will be the first to recover. In the ordinary lines of machine tools, both manufacturers and dealers are still overstocked and there is doubt if more than a small percentage of the machine tools sold from Government stock have gone into service. Buyers of machine tools realize that machine tool builders can deliver stock machines to meet any emergency; hence they hesitate to purchase with a view to having equipment on hand for future production.

Machine Tool Prices

Although most machine tool makers are no doubt open to offers for their products, there is no tendency toward a general slump in prices. A substantial decline in machine tool exports or a large influx of foreign tools might have a serious effect on prices, but neither of these conditions is likely to arise. America has a good stock of machine tools in the country but there are no signs of selling at low prices. The downward movement of prices in general is rapidly slowing up, for the simple reason that it is impossible to produce new supplies at a lower cost.

During 1919, when prices had reached a zenith, machine tools averaged two and one-half times the 1914 values; they have now fallen to about twice these values. As general prices appear to be finding a level at about one and three-quarters to twice the pre-war levels, it will be seen that machine tool prices are in keeping with other products. In the machine tool industry several of the costs, such as fuel, railway rates, packing and many general supplies, have risen above the average increase for other commodities. Machine tool makers cannot be held responsible for this.

General Engineering

Motor car manufacturers continue to be in a strong position; demand is unabated and in the trade there is no accumulation of stocks. The disturbance of production systems owing to recent trouble has seriously upset delivery dates and in several sections of the industry multiple shifts are being worked in an endeavor to hasten the lagging production that is holding up delivery of complete cars.

There is a renewal of activity in railway car and locomotive shops, and substantial orders have been or are about to be placed. Among these may be mentioned materials to the value of £60,000,000 to be used in a big scheme of Indian railway reconstruction that has been postponed since 1914. The contracts will take ten years to complete. The Caledonian Railway Co. has ordered twenty new locomotives from the North British Locomotive Co., Glasgow, and the same railway company has placed orders for five hundred cars from Hurst, Nelson & Co., Motherwell.

An improved demand is urgently needed in the marine engineering and shipbuilding industry. British yards, however, are competing with more success for repair work that has been going to the Continental yards. The future is uncertain, and may remain so until the important questions of oil supply and control are satisfactorily settled. Upon this hinges, to a large extent, the type of prime mover which will be installed in the future, and the internal arrangement of the ships themselves.

An order has been placed by the United Fruit Co. of Boston with Cammell Laird & Co., Ltd., for three 4000-ton insulated motor ships. These will be driven by electric motors, with Camellaird-Fullager Diesel engines as prime movers.

The textile machinery trade is active, the demand being well sustained; moreover there are many orders that await completion. Wireless broadcasting is likely to develop very rapidly and the manufacture of the apparatus used in connection therewith will be largely a new industry. In the iron and steel trades, the position shows little change compared with a month ago.

The Foundry Trades Exhibition

The International Foundry Trades Exhibition was held at Bingley Hall, Birmingham, during the latter part of June. Out of a total of 178 malleable iron foundries in this country, 134 are in the Birmingham area; most of the non-ferrous foundries and nearly 1000 out of 2800 gray iron foundries are in the same area, indicating the great importance of Birmingham to the foundry trade. The exhibition served to show that there are now quite a number of British firms producing molding machines of all types and sizes. There is also evidence that foundries in this country have developed their technical resources considerably and have at the same time been wide awake to any improvement introduced on the Continent or in America.

Overseas Trade in Machine Tools and New Equipment

During May the exports of machine tools reached a value of only £114,372 as compared with the April return of £171,612. The value per ton rose from £121 to £139. Imports fell during May from 266 to 250 tons for the month, the value per ton falling from £116 to £97. The latter is a lower figure than has been registered for a very long period. How much of these reductions in trade are definately due to the lock-out and its concomitant troubles, it is not easy to say, but last month's returns show a decided falling away from the promise of the previous few months.

Prominent among new machine tools is an 8½-inch lathe by Dean, Smith & Grace (1908), Ltd., Keighley. Since being first placed on the market some eighteen months ago, several new and interesting features have been added. One of them is an arrangement of supports for long lead-screws. At each side of the saddle the lead-screw is supported by jacks that are automatically moved into and out of position by the movement of the saddle as it is traversed. The result is an adequate support and a prevention of any undue sagging, while at the same time there is no obstacle left in the path of the saddle.

The Cambridge & Paul Instrument Co., Ltd., London, have introduced a furnace temperature controller that can be easily applied to any type of furnace fitted with an indicating pyrometer. The controller is suitable for the lowest temperature recorded by resistance thermometers up to the highest temperatures indicated by Fery instruments.

MAKING OVER-SIZE PISTON-RINGS

The manufacture of piston-rings involves skilled workmanship and careful inspection methods to insure the necessary degree of accuracy. The Houpert Machine Co. of Long Island City, N. Y., manufactures over-size piston-rings for its own use in refitting reground cylinders. The manufacturing methods employed by this company in making rings are here briefly reviewed.

Milling the Lap Joint in the Rings

The piston-rings are made from individual castings and are finished all over. They are concentric in form, and are sometimes provided with a lap joint and sometimes with an angular joint. Before cutting the joints, the castings are ground on the sides on a Heald rotary surface grinding machine, and rough-ground on the outside diameter on a cylindrical grinding machine. The method of milling the lap joint is illustrated in Fig. 1. This work is done on a duplex type of hand milling machine, the heads of which are provided with suitable adjustment so that the end-mills may be offset as required to produce the joints.

The rings are abutted against two pins and are located against the scraped surface of the heavy cast-iron angle-plate *A*. A parallel clamp *B* is secured against the opposite side of the ring, and operated by a capstan wheel at the front of the machine. The capstan wheel is fastened to an operating screw, one end of which tapers and extends into a corresponding hole in the clamping member *C*. This member is simply a short shaft, set at an angle in bracket *D*, and provided with an adjusting nut *E* so that various widths of piston-rings can be accommodated. When the operating screw is advanced by the capstan wheel, its tapered end moves member *C* forward, and forces the clamp *B* against the ring. Two coil springs attached to the clamp, one above and one below, free the work when the clamp is released.

This device is attached to the table of the milling machine, and the ring is fed by hand against the end-mills, thus producing the lap joint. When the two cuts that produce the joint have been completed, and the milling machine table has receded, the capstan wheel is turned, releasing the clamp and permitting the ring to drop into a receptacle beneath.

Finish-grinding and Boring

The next machining operation consists of finish-grinding the outside diameters. The rings are taken to a bench, where the grinding arbors are loaded with rings, but before loading on the arbors, the lap joint is faced off slightly at the ends, on the side of a disk grinding wheel. In loading the arbors, the rings are compressed between four high jaws, arranged radially 90 degrees apart on a faceplate, which are adjustable for different diameters of rings. While the rings are thus compressed, the arbor is run through them and they are clamped from the ends. The jaws are then removed and the arbors placed between centers in the grinding machine. The last machining operation required to finish the rings all over is boring. A quantity of rings are arranged in a suitable chuck and a boring-bar fed through them.

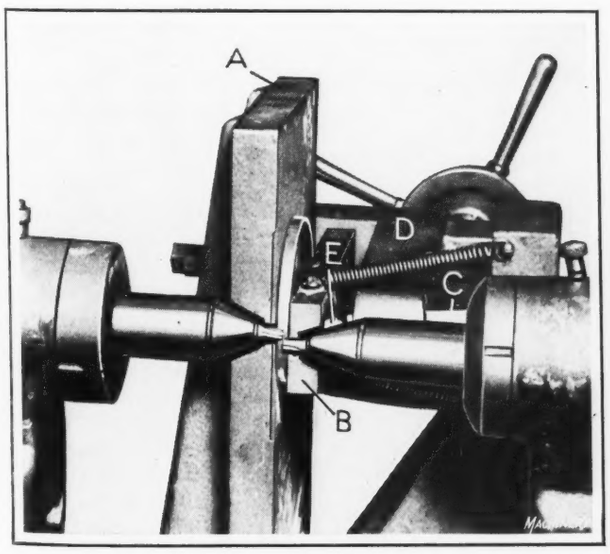


Fig. 1. Duplex Hand Milling Machine with Piston-ring Clamping Device



Fig. 2. Grinding Ends of Lap Joint before gaging for Expansion

Fitting the Rings to the Cylinder Bore

Finally, the rings are fitted to the cylinder bore. Although this is apparently a simple operation, it is of great importance, and the work must be carefully done. An allowance must be made for exactly the right amount of expansion; if the rings fit too tight, the cylinder bore will become excessively worn after being in use only a short time; and if the rings are too loose, the result will be poor compression and a consequent loss of power. The fitting operation consists simply of grinding the ends of the joints to allow the proper amount of clearance after the rings have been compressed in the bore. The operation is illustrated in Fig. 2, which shows a disk grinder and the Norton elastic wheel used. The wheel is 8 inches in diameter by ⅛ inch thick. It is made of No. 46 grain abrasive and is No. 4 grade. A cast-iron gage in the form of a cylinder is used, into which the rings are compressed, the joint being exposed through a slot in the side of the cylinder. Long experience enables the operator to determine with little experimenting the amount of metal that must be removed from each end of the joint in order to furnish the proper clearance.

From time to time a thickness gage is used between the joint, this gage being of proper thickness to agree with predetermined allowances for expansion. These allowances vary, of course, with the sizes of the rings. For example, for a 4⅞-inch ring, such as here shown, a flat gage 0.010 inch thick is used, although the allowances may range from 0.006 to 0.012 inch. After the operator has ground three or four rings and compressed them into the gage, he removes them and uses the last one to locate the next three or four, usually gaging this locating ring only. Both ends of the lap joint are ground, an equal amount of metal being removed from each.

Effect of Design on Drilling Machine Efficiency

By F. E. JOHNSON

IT is often the case that a machine is lacking in certain essential points of design, with the result that the tools employed are subjected to various kinds of strains, stresses, or shock. Vibration, friction, and deflection of machine members are factors that must be overcome in producing different classes of machine tools. It is proposed to discuss in this article certain important factors in the design and operation of drilling machines, and to advance suggestions for improving the operative conditions commonly found in machines of this type.

The advent of high-speed steel made it compulsory for machine tool builders to make radical changes in the design of their machines in order to meet the new requirements. Many of the earlier types of machines, which were originally designed to employ carbon steel tools, have not been able to resist the strain set up when it was attempted to drive high-speed tools at their maximum capacity. The weaknesses developed also reacted on the tools with a destructive effect. Consequently, the quality of the work was not of the best, production was insufficient, and the expense for machine repairs was high. Vibration in an efficient quantity-production machine must be overcome as far as possible, and in order to do this and prevent the tools from chattering, it has been found necessary to employ mass design wherever practicable. The machine designer, in creating a new product, is almost wholly dependent upon his general knowledge of the successful adaptation of well-known elements of machine construction. The development of a new machine is also contingent upon certain other factors, such as knowledge of minute mechanical details and how they may be best incorporated in the design.

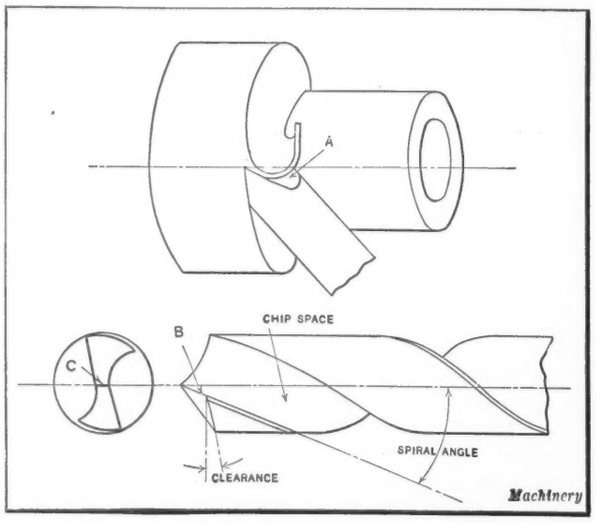


Fig. 1. Diagram used in analyzing the Cutting Action of Twist Drills

Diminishing the Amount of Sliding Friction in Machine Parts

Friction between parts of a machine consumes excessive power for operating. It also produces heat and wear of the parts. The effect of friction is greatest in heavily loaded machine parts which are slow-moving. This includes common slides and sliding shafts. The wear caused by friction decreases as the velocity of the parts increases; for high pressures, the friction is very great at low velocities. If bearing surfaces are flooded with oil, the friction is almost independent of the materials from which the parts are made, because it is the film of oil between the parts, rather than the parts themselves, with which the bearing surfaces come in contact. Theoretically, well lubricated contact surfaces do not bear against each other at all. The matter of sufficient lubrication for machine tools is therefore an important factor in their design.

The frictional losses in a drilling machine represent a large percentage of the power delivered, it being estimated that there is seldom more than one-fifth of this power which is actually transmitted to the point of the drill. This is apparently due to the nature of the cut which the drill takes, which is radically different from the cuts taken by most other cutting tools. By the use of ball and roller bearings, rolling friction is substituted for sliding friction, which results in reduced costs and power for driving the machine. In former times when the common plain type of machine bearing was used, it was impossible to obtain or maintain the velocities necessary in many modern machine tools. At the present time drilling machines, which are fully equipped with ball bearings, are available for operation at speeds ranging from 3000 to 10,000 revolutions per minute.

Direct Application of Motive Power

A point of importance in machine design is to apply power in as direct a manner as practicable. The interposition of a considerable number of shafts or other machine parts between the point of power application and the point of useful application, where power is applied to driving the tools, results in an increase in the total power requirements to operate the machine. The general arrangement of the machine parts in the assembly of a machine, as well as the number of parts which must be used and kept in motion, should always be carefully considered in machine design if most satisfactory results are to be obtained.

Drills and their Cutting Action

There are several rules that influence a machine operator in selecting speeds and feeds which he may safely follow on a particular piece of work with the available equipment. These rules are: (1) If the tool chips out at the cutting edge, the feed is too great or the drill has been ground with an excessive lip clearance; (2) a drill split along the web *C* (see Fig. 1), is evidence of too heavy a feed or of being ground with insufficient lip clearance at the center of the drill; and (3) when the extreme outer corners of the cutting edges wear away it is proof that the speed is too high.

Drills vary in hardness as much as other hardened tools, but the chipping out of steel at the cutting edges under a heavy power feed is more pronounced in drills than in other tools. This fact is due largely to the peculiar and severe duty that a drill performs. The action more nearly resembles tearing the metal than shearing or cutting it. The action of the point of the drill is one of crushing the metal, and this must be done first by the web before the cutting action can be performed by the lips. The drill point itself must be forced into the work and the metal crushed ahead of it before the lips can start to cut. A large drill requires

great pressure behind it to bring about this crushing of the metal; for this reason when drilling large holes in tough materials, it is often advisable to start them by first drilling through with a drill of smaller diameter.

The action of the lips of the drill (not the drill as a whole) in removing the metal, is very similar to that of a turning tool, as shown at *A*, Fig. 1. By comparing the general formation of the lip of the drill at *B*, including the lip clearances, the great similarity that exists between the drill at this point and the cutting tool may be noted. By allowing sufficient top rake, the efficiency of the tool shown in the upper part of this illustration could be such that very little power would be consumed in feeding it laterally, as in a turning operation. Excessive top rake, however, gives the tool a tendency to pull itself into the cut, because the force required to curl the chip reacts on the tool. For the same reason, excessive lip rake will make it more difficult for the lips of a drill to curl the chip than to penetrate the work.

then, an important factor when considering the cutting action of a drill.

Factors Affecting Drilling Machine Efficiency

The speeds and feeds with which a drill may be operated depend largely upon its design and the material from which it is made, as well as upon the nature of the material to be worked. High-speed steel drills may generally be operated at double the speeds permissible in operating carbon steel drills. The length of time during which it is possible to operate a drill continuously under heavy feed, provided it has all the essential requirements of design and durability, depends upon the smoothness and efficiency with which the machine is capable of driving the drill. Weight, stiffness, and rigidity are necessary to counteract and absorb the vibration that is transmitted to the drill point. Rigidity is also required to prevent serious deflection of the machine frame and work-table—deflection caused by heavy feed pressures.

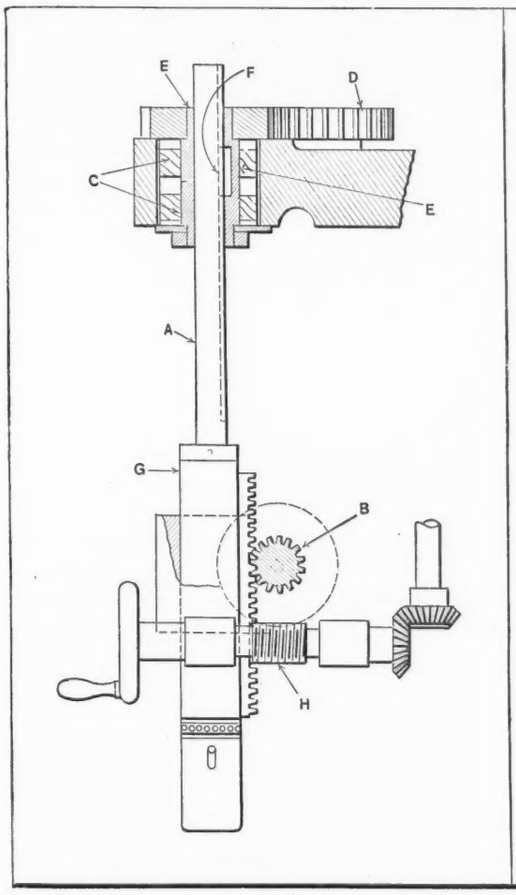


Fig. 2. Drill Feed and Spindle Drive Mechanism of Common Construction

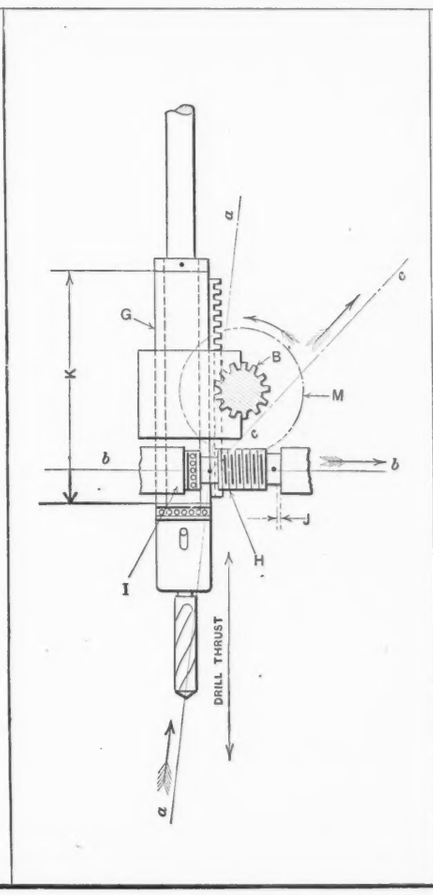


Fig. 3. Diagram indicating Thrusts set up in drilling

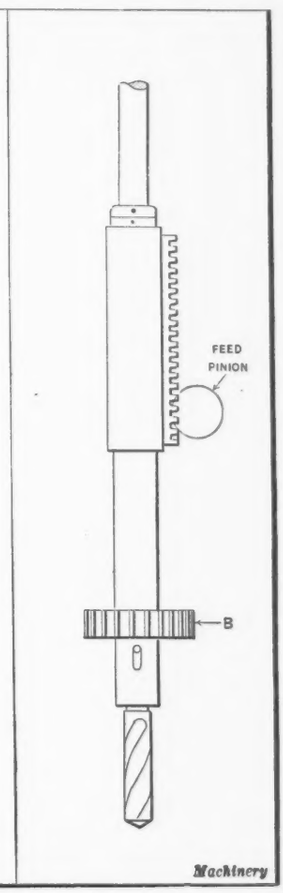


Fig. 4. Drill Spindle with Drive Gear near Nose

The web *C* is not in itself capable of any real cutting action. As previously stated, the duty that a drill must perform is more severe than is imposed on most other classes of cutting tools. The web of a drill must be comparatively thin in order to reduce end thrusts, and also to provide sufficient chip space. A small section is also necessary in order that the drill may cut properly. Because of the resistance which the machining of such metals as steel, wrought iron, and bronze offers, it is sometimes the practice to relieve the bluntness of the drill at the point by hand-grinding.

It has been determined that the feed pressure is greatest where the drill enters the work. At that stage where the lips begin cutting, the feed pressure is reduced somewhat. This is due to the fact that the top face or rake *B* of the drill lips, which is formed by the spiral angle of the drill, is sufficient in certain cases to assist in pulling the drill into the work. The spiral angle or rake of a twist drill is,

Efficiency of power transmission to the drill point is important in obtaining smoothness of drill feed motion and drill spindle rotation. If the feed motion is irregular or jerky, due to friction, vibration, or backlash of machine parts, the drill point will suffer from continual shocks. It is probable, however, that there are no drilling machines that are not subject to some vibration in a greater or lesser degree, due either to the moving members of the machine or to disturbances caused by floor vibration. In drilling machines on which a heavy power feed is employed, the rate of feed in breaking through a hole is often accelerated over the normal feed, because of the reaction of different machine members which are under strain up to the time that the thrust exerted by the drill is relieved, and because of backlash that exists between the different machine parts. The material being drilled will vary, in many instances, in resisting properties, so that a varying deflection and strain

in the operative machine parts is set up, together with a corresponding reaction when the strain is relieved.

Analysis of the Spindle Drive and Feed Mechanisms

The principle of a drill-spindle feed and drive arrangement such as is found in most classes of medium size and heavy-duty single-spindle drilling machines is illustrated in Fig. 2. The drill spindle is indicated at *A*, and the combined pinion and shaft which transmits the feed motion to the drill through a rack, at *B*. All the shafts which are interposed between the main driving pulley or motor and the mechanism indicated in the illustration may be mounted on ball or roller bearings to avoid frictional losses in the driving power. The friction caused by driving the drill spindle is generally relieved by placing ball or roller bearings at *C* to relieve the side thrust exerted by gear *D* upon the spindle drive gear. This driving gear is made fast to sleeve *E*, or the sleeve may be an integral part of the gear. The sleeve drives the drill spindle by means of the gear and a key *F*. It is customary to place a ball bearing at the lower end of the spindle sleeve *G* to receive the thrusts due to the feed. This ball bearing should be provided with a dust-proof cover to protect it from grit and flying particles which would cause injury or excessive wear. Before the use of a ball bearing at this point in the construction of a drilling machine became common, it was the custom to use steel and fiber washers in order to reduce heating and friction.

Heavy-duty drilling machines must be constructed with a very rigid frame. A serious deflection of the frame of a drilling machine due to heavy feed pressures results in a drill binding in the sides of the hole. Great pressure is brought to bear upon one side of the key *F* due to the resistance offered to the rotating action of the drill by the work. The resistance of the work sets up torsional strains in the drill spindle and drill, which is similar in effect to the results produced by the torsional strains in a shaft. Drills are most often broken, or shank ends twisted off, because of excessive strains of this kind. Breakage generally occurs when the drilling of a hole has been nearly completed, and where the drill point is about to break through.

The side strain on key *F* is sufficient in heavy-duty work to prevent a smooth sliding action of the machine spindle. When the feed is engaged, the key slides in a long keyway in the spindle, and when the key is subjected to considerable side strain, this results in a binding effect on the spindle. The action of a drill spindle when great strain is imposed upon the key is particularly noticeable in tapping holes of large diameter, because the spindle must be forced forward or the threads will be stripped. Special tapping chucks containing ball-bearing keys are now being manufactured, by the use of which rolling friction is substituted for the sliding friction produced in the keyway of an ordinary drilling machine spindle.

A large amount of the thrust of a drill is taken by the slow-moving pinion-shaft *B*. The friction at this point is very great under heavy drill pressures, necessitating extra power to operate the machine. It is the practice to mount this shaft in plain bearings, since it is not a rotating shaft in the same sense as are other shafts contained in the machine. On most jobs this shaft is not required to make even one complete revolution during the entire feeding movement. If it were practicable to use ball or roller bearings to support the shaft at this point, the amount of power consumed in operating the machine, when engaged in heavy-duty work, would be greatly reduced. In addition, the increased smoothness of drill feed motion transmitted to the drill by thus eliminating much of the friction at this point, would result in more efficient operation of the machine. Reduced abrasion of worm *H* and the worm-wheel with which it engages would lessen the possibility of backlash between these two members. There is also a certain amount of friction developed between the spindle sleeve *G* and its bearing on the machine frame, due to the side thrust exerted by pinion *B*.

Fig. 3 illustrates certain other points in drilling machine construction which directly affect the efficiency of a drill. The pinion-shaft *B* which is keyed to the worm-wheel *M*, transmits the feed motion to the drill spindle rack through the rotation of worm-wheel *M* by worm *H*. The thrust produced by feeding the drill into a piece of work is indirectly transmitted to the face of the worm-shaft bearing *I*. The worm, in feeding the worm-wheel *M* in the direction indicated by the arrow, meets with resistance to motion which has the result of forcing it back against this bearing. This results in great friction being produced at this point.

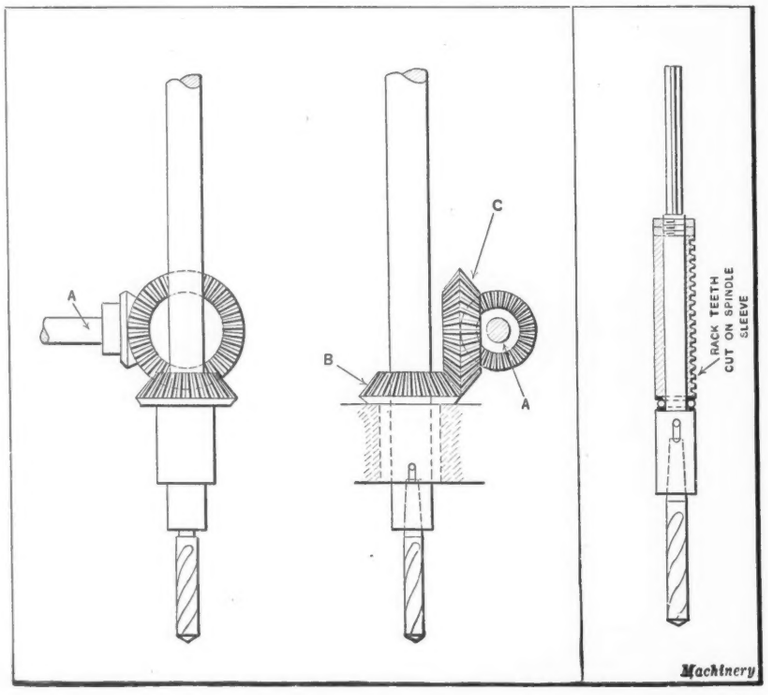


Fig. 5. Radial Drilling Machine Spindle with Drive Gear brought Close to Spindle

Fig. 6. Spindle with Rack cut in Sleeve

Line *a-a* represents the force which is set up by the drill feed pressure, and *b-b* the resistant force produced as explained in the foregoing. The line *c-c* is the resultant of the two forces which act upon the pinion-shaft *B*, the direction of the different forces being indicated by arrows. Efficient drilling machines equipped with a drill feeding mechanism of the type described should have a ball thrust bearing between the end face of the worm and the end face of bearing *I*, as shown in the illustration, in order to reduce the friction generated at this point.

Action of Drill-feed Mechanism under Heavy Duty

In following out and studying the action which takes place in the drill-feed mechanism under heavy duty, and its effect on the drill, it may be assumed that the material to be drilled is machine steel and that the pressure exerted by the pinion-shaft *B* is 200 pounds. When the drill has nearly passed through the work, the strain upon the drill spindle driving key *F*, Fig. 2, is relieved, because the resistance to driving the drill spindle offered by the work is reduced. The power necessary to force the point of the drill into the work is not a factor at this stage of the drill-

ing operation. The result is that the grip of the key on the spline in the drill spindle is partly released. Simultaneously the energy stored in the drill spindle causes it to be thrust forward an amount depending partly upon the backlash in the different machine members, as emphasized in discussing factors bearing on operative efficiency. The cutting lips of the drill (not the point) are not capable of offering great resistance to the accelerated feed movement thus brought about. If the rake on the lips is excessive, there is an increased tendency for the drill to pull itself through the hole which is nearly completed. The weight of the spindle and sleeve will assist in causing an accelerated feed movement if the spindle sleeve moves freely in its bearings and if backlash exists between the spindle rack and the feed pinion.

If, in the drilling process, the machine frame is sprung upward and the work-table downward, the reaction of these members, when the strain upon them is released, combines with the other factors mentioned, to impose a severe torsional strain upon the drill. The general effect of these conditions upon the drill, together with the excessive torsional strain imposed upon it, results in breakage of the drill. The chipping of drill lips when a heavy rate of feed is used is undoubtedly due, to a great extent, to the reasons mentioned. If the material being machined is comparatively soft, such as brass, for example, the tendency to increase the feed movement in the drill at the point where it breaks through the work is naturally greater. The turning of brass requires a cutting tool with negative top rake in order to prevent it from hogging into the work, and for the same reason it is necessary when machining brass with a twist drill to grind the lips by hand so that they have no top rake at the cutting edges.

Backlash between the different machine parts, due to wear or to improper fitting, may prove to be highly detrimental to the operation of the machine under certain conditions. In such cases a positive motion in its true sense does not result from the combination of so-called positive machine members which are involved.

Play and lost motion in the drill feed mechanism illustrated in Fig. 3 may result from wear or improper fitting at *J* and between the teeth of worm *H* and worm-wheel *M*. A worn condition of the spindle rack and the pinion *B* also results in developing backlash at this point. If the adjustment at *K* where the drill spindle is contained in sleeve *G*, is not properly made, the play at this point may be serious when there is a tendency for the drill to pull itself ahead as it breaks through. Play between the spindle and the sleeve would partially offset the advantages resulting from having all other operating conditions satisfactory.

Examples of Drilling Machine Spindle Drive Construction

Fig. 4 shows a drill spindle which has the drive gear *B* applied at a point close to the nose of the spindle. This construction is used in a certain make of radial drilling machines. The objective aimed at in this design is the elimination of torsional strains developed in the spindle when engaged in heavy-duty drilling. A portion of another radial drilling machine spindle drive is shown in Fig. 5. Here the spindle driving gear *B* is also brought close to the drill. Another feature of design is the elimination of as many intermediate driving shafts as possible between the motor and the drill spindle, in order to reduce friction. In attempting to eliminate torsional strains, the main drive shaft *A* has been brought close to the drill spindle by interposing a double-faced bevel gear *C* between the driving shaft bevel pinion and the spindle driving gear.

In order to reduce side thrust and to apply power more effectively, it is desirable to have the drill feed pressure applied as close to the axis of the drill spindle as possible. This is effected in certain makes of machines by cutting the rack teeth directly in the sleeve, as shown in Fig. 6, instead of employing a separate rack, as in the most common construction.

SCARCITY OF LABOR AND INCREASED DEMAND FOR MACHINERY

By ERNEST F. DuBRUL
General Manager, National Machine Tool Builders' Association

It is well to consider the present situation of the labor market. In many quarters there is even now some scarcity of labor, particularly skilled labor. The restriction of immigration certainly makes for a scarcity of common labor that will become evident as the building program progresses. It is said in the Pittsburg and Chicago districts that it would be impossible for the steel works to operate at more than about 70 per cent of their capacity, because of the scarcity of common labor.

The machine tool builder during the war did not train any all-around skilled labor. His orders came in such quantities that he was able to train and use more specialists, and as a matter of necessity he did not find time, even if he had the disposition, to train a more general class of workmen. Now that his orders are likely to be for smaller quantities, he is going to need more all-around men. Even most of the specialists that he trained and laid off after the boom have drifted into other industries. When the demand for machine tools becomes great enough to absorb all the stocks that are now on hand, the machine tool builder is likely to find himself in a bad labor market, with his costs considerably higher than he may now anticipate. It would not then be surprising to find labor costs as high as they were, and perhaps even higher, because of the smaller quantities to be produced with a very great shortage of good mechanics to produce them. It would appear that a machine tool plant that would accumulate a reasonable amount of stock now, would be doing the wise thing.

Scarcity of labor will naturally have another influence on the demand for machine tools by making it necessary for the world to use more machinery of all sorts than heretofore to supply its wants. Of course, a great deal can be done to use present machinery and equipment with more efficiency. "The Report on Industrial Waste" shows a great field for this, and scientific management and industrial engineering can develop methods for producing more with the same amount of equipment. But most managers are not able to apply scientific management very freely, and as the growing scarcity of labor becomes more apparent, there will be a natural increase in demand for industrial equipment of all kinds. Machine tools form about 25 per cent of the demand for all sorts of industrial machinery, according to the United States Census of Manufacturers. The man who is in need of equipment of any kind would do well to anticipate his requirements. It will not take much activity to create a demand in excess of the supply in a restricted labor market.

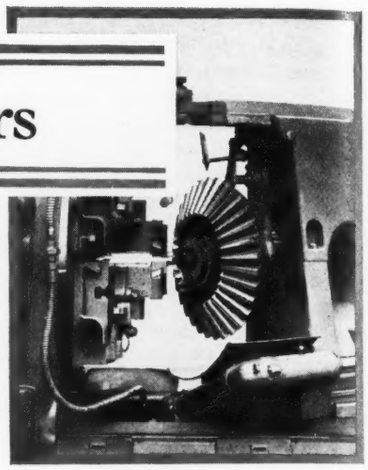
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SAVINGS BY MODERN EQUIPMENT

The machine tools for which there is the greatest demand are those which can be shown to definitely reduce production costs. One manufacturer mentions how, by installing an automatic milling machine, he is able to produce forty parts of a certain product a day as compared with fourteen parts previous to the installation of this machine. In another case, a builder of railroad cars by installing a better drilling equipment than that formerly used, is now drilling seven hundred holes in an eight-hour day, using one operator. In the past, eight operators were required to drill that number of holes in one day. Improved facilities are the order of the day, and savings are made not only in the greater efficiency of machines, but also in the handling of the work. The installation of a certain type of hoist in an automobile plant may be mentioned as an example of the savings that can be made in the proper handling of work. This hoist saved its cost in two weeks.



Cutting Bevel Gears



Principal Adjustments Required in Setting up Gleason Bevel Gear Generators and Time Required for Cutting Gears of Different Sizes and Pitches—Second Installment

By FRANKLIN D. JONES

THE types of Gleason bevel gear generators to be considered first are used for cutting "straight-tooth" bevel gearing. The term "straight tooth" is used to distinguish between the ordinary bevel gears and so-called "spiral bevel" gears. These generators are so designed that the generating motion is applied to both the gear and the planing tools, as shown by the diagram Fig. 2, of the previous installment; that is, the machine operates on the principle of a gear and crown gear rolling together. In fact, segments of these gears are actually used to obtain the required generating or rolling motion between the gear blank and the cutting tools. These machines are used almost exclusively for finishing the teeth of gears that have been roughed out on machines especially adapted for this purpose. Special roughing machines will be considered in an article to be published later.

The bevel gear planer shown in Fig. 1 is an 18-inch size. A rear view of a similar machine set up for planing a gear of larger size is shown in Fig. 2. An important feature of the Gleason generator is that it has two tools for planing opposite sides of a tooth. One tool is cutting on the forward stroke while the other tool is returning, and each tooth is finished before the gear is indexed to present the next one to the cutting tools. The use of two tools increases production, and by operating the tools in opposite directions, vibrations are minimized.

The crown gear segment *A* (shown in Fig. 2) is attached to the outer end of the frame carrying the tool-slides. The master gear segment *B* is bolted to a large yoke or "generating arm" *C*, which is pivoted at one end and is connected to the work-spindle sleeve at the other end. This is a splined connection, so that the spindle sleeve oscillates with the arm, but may be adjusted longitudinally for setting the gear to be cut, so that the apex of the pitch cone coincides with the "center of the machine."

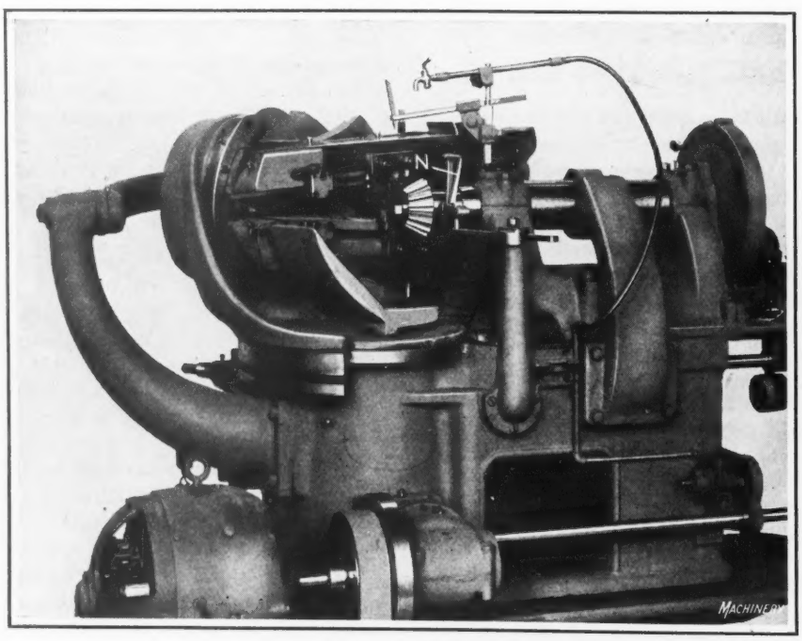


Fig. 1. Gleason 18-inch Bevel Gear Generator

When the machine is at work, the generating arm is slowly oscillated or given a swinging movement upward and downward by means of a cam acting through a slotted elevating arm *D* and adjustable connecting link. This motion is imparted to the gear blank and, through the master and crown gear segments, to the cutting tools. The tools represent the sides of mating crown gear teeth of the same pitch and pressure angle as the gear being cut. They follow lines converging toward the apex of the pitch cone, and, since the rotary motion between the gear blank and the reciprocating tools is like a crown gear revolving in mesh with a finished gear, teeth of the correct curvature are generated.

The diagrams in Fig. 3 show how a roughed out tooth is formed as the gear and tools roll together. Diagram *A* shows the tools at the beginning of the generating motion, diagram *B* the central position, and diagram *C* the completion of the cut. The tools are first swung inward to the cutting position (diagram *A*) by a cam; then arm *C* (Fig. 2) swings upward slowly until the particular tooth being planed rolls around out of contact with the tools, as shown by diagram *C*. During this generating movement, the two planing tools are taking a succession of cuts across each side of a tooth.

Order of Movements for Single- and Double-roll Machines

Most of the Gleason machines designed for cutting gears by a generating process finish a tooth during one rolling or generating motion as just described, but some machines repeat the generating action, and the tooth receives a light finishing cut during the second part of the movement. The first or single-roll method is illustrated at *A*, Fig. 4. After the tools are in the proper position for cutting teeth of the required depth, there is an upward generating motion, during which the sides of a tooth are finished, as explained in connection with Fig. 3. The tools then back

out (or the work swings away as on certain other designs of Gleason bevel gear generators), and, after the indexing movement, the tools again feed in to depth; backing out, indexing, and feeding in occur during the downward rolling motion, as the arrows indicate.

Diagram *B*, Fig. 4, illustrates graphically the action of a double-roll type of generator. After the tools feed in to the cutting position, there is an upward generating movement the same as when using a machine of the type referred to in connection with diagram *A*. While the tooth thus formed is accurate enough for practically all purposes, some manufacturers requiring gears of extra fine quality consider it preferable to take a second very light finishing cut. On a double-roll generator this is done (as represented by diagram *B*) by simply reversing the generating motion, thus allowing the tools to pass again across the tooth surfaces while returning to the starting point; the tools then back out and the work is indexed. Most of the Gleason "straight-tooth" generators, and all of those used for spiral bevel gears, are of the single-roll type (diagram *A*).

A third cycle of movements, shown by diagram *C*, and known as a "completing" cycle, may be employed, although this arrangement is seldom used and is adapted only for machines cutting gears of small pitch, which can be finished complete "from the solid," during a single generating movement; the backing out is followed by indexing.

General Procedure in Setting up a Machine

The principal adjustments required in setting up a Gleason generator of the type shown in Fig. 1 will be explained without attempting to cover every step in minute detail. In order to understand the reasons for different adjustments, it is well to remember that the turret or base carrying the tool-slides is adjustable about a vertical axis, which coincides with the horizontal axis of the work-spindle. The gear blank must be so located that an imaginary point representing the apex of its pitch cone coincides with this vertical axis. This central point is known as the "center of the machine." The turret carrying the tool-slides is adjusted about this vertical axis in accordance with the angle of the gear to be cut. Another angular adjustment of the tool-slides is required for the reason that the opposite sides of a bevel-gear tooth converge toward the apex of the pitch cone. To secure this adjustment, the tool-slides at one end are arranged to swivel about a bearing, the horizontal axis of which coincides with the center of the machine.

The mechanism operating the generating arm which carries the master-gear segment must be adjusted to give the arm the right amount of throw, and a suitable master gear must be attached to the arm. A series of master gear segments are supplied with the machine to provide for different angles. The number of strokes per minute made by the tools is regulated by change-gears, and the length of stroke is governed by changing the radial position of the driving crankpin. The indexing movement is also regulated by change-gears selected (by referring to a table) according to the number of teeth in the gear to be cut. After a gear is finished, the machine is stopped automatically by a mechanism that is set according to the number of teeth in the gear. The different adjustments and the general method of arranging the machine for cutting gears of a given size and pitch will now be explained in somewhat greater detail.

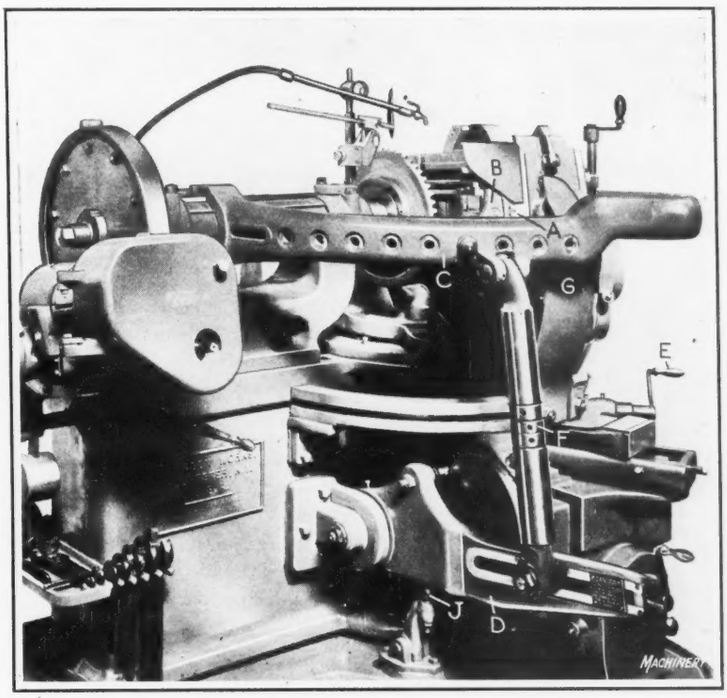


Fig. 2. Rear View of an 18-inch Generator

Tools Used on Bevel Gear Generator

The tools are selected according to the pitch and pressure angle of the gear teeth to be cut. The angle a, Fig. 5, of the tool is the same as the pressure angle of the gear. The length L must not be less than the tooth depth at the large end, and the width W of the point should be at least 0.015 inch less than the width at the bottom of the tooth space measured at the small end.

Fig. 6 illustrates how the tools are set. A gage *A* is held firmly against the tool-slide arm, and tool *B* is first adjusted, by means of adjusting screw *C*, until the point or end just clears the gage. The wedge adjusting screw *D* is then used to shift the tool vertically until the cutting edge is within, say, 0.0005 inch of the gage. The lower tool *E* is set in the same manner, after applying the lower gage to the lower arm.

Angular Position of Tool-slide Arms

The two tool-slides are set at an angle to each other, because of the converging form of the teeth to be cut, by means of suitable graduations. The tooth angle used in making this adjustment is given on a chart; the tangent of the angle may be obtained as follows: Add to one-half the thickness of the tooth at the pitch line the product of the flank depth or dedendum times the tangent of the pressure angle, and divide the result by the cone distance.

The travel of the turret that supports the tool-slides is regulated by adjusting the cam-lever through which this turret is operated. The required angular movement of the turret may be found by subtracting the root angle of the gear from one-half the included angle of the blank and then adding one degree. This turret is set to the root angle of the gear to be cut, adjusting crank *E*, Fig. 2, being used for this purpose after certain nuts have been loosened.

Before making this adjustment, a "double-roll" machine (11-inch and 18-inch) is started and is allowed to run until elevating arm *D* has passed its upper position and has lowered slowly on jack *J*. This jack serves to hold the arm in its mid-position, and is used for certain adjustments to follow. With "single-roll" machines (3-inch and 6-inch) the adjustment for the root angle is made when the generating arm is at about the middle of its "up" roll.

Adjustments of Master Gear and Crown Gear Segments

The gear segment on the generating arm is selected by reference to a chart. Each segment in the series supplied with the machine covers a certain range of pitch cone angles, and the selection is based on the angle of the gear to be

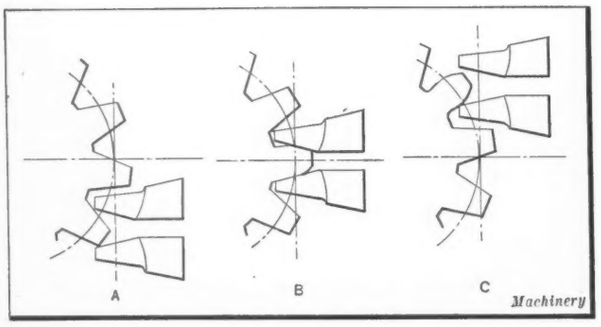


Fig. 3. Diagrams showing the Manner in which Gear and Planing Tools roll together

cut. As Fig. 2 shows, the generating arm has a series of bolt holes so that any gear segment that is used can be located according to its angle. The crown gear must be set according to the block angle, which is the difference between the root angle and the pitch cone angle. Graduations on the crown gear are used for this purpose. A marked tooth on the segment is placed in the center space of the crown gear, and the segment can be centered in the crown gear by adjusting turnbuckle *F*. Just back of the crown gear there is a spring-supported thrust-block that is carried by brace *G*, which also requires adjustment.

Regulating Extent of Rolling Movement

The rolling or swinging movement of the generating arm is regulated by adjusting the lower end of the connecting-rod along the slotted elevating arm *D*. The diagrams (Fig. 3) illustrate, in a general way, the amount of rolling motion necessary between the tools and the work. When the tools swing in at the proper point, as shown by diagram *A*, and then roll upward with the work until they have stopped cutting, as in diagram *C*, any additional rolling motion is unnecessary.

On the elevating arm *D*, Fig. 2, there are graduation lines to assist in regulating the rolling motion, and numbers indicating the corresponding segment number for each position. To begin with, the connecting-rod can be set according to the number of whatever segment is being used, because this position is based on the greatest pitch cone angle for which the segment is intended. If the pitch cone angle is smaller, the rolling movement can be increased accordingly. The smaller the angle, the greater the amount of roll necessary. The swinging movement is equalized by turnbuckle *F* at the center of the connecting-rod, so that when the cam-lever is resting on jack *J*, the tool-slide frame is in the zero position. This adjustment is checked by starting the machine and noting the angular movement each side of zero.

Endwise Adjustment of Gear Blank

In order to locate the gear to be cut so that the apex of the pitch cone coincides with the center of the machine, the head that carries the work-spindle is adjusted along the bed until a cone distance gage *H*, Fig. 7, shows that the gear blank is in the correct position. With the cam-lever *D* on the jack *J*, Fig. 2, the machine is run until the turret has moved to its extreme outer position. The machine is then operated by hand until the turret has moved in to the face angle. Sliding bar *K* (Fig. 7) of the cone distance gage is next adjusted until the zero lines coincide. The gage is then placed on the tool-slide arm as shown, and after loosening the binder bolts, the work-spindle head is moved up by means of an adjusting crank; at the same time the gage is moved along the arm until the zero lines at the top of the gage pointer *L* meet when the lower end of the pointer is in contact with the top of a gear tooth at the large end.

After one gear of a lot has been set in this manner, the machine is run until the turret stands at the root angle and the generating yoke is about level. This will be at the middle of the down roll for the 11-inch and 18-inch generators, and at the middle of the up roll for the 3-inch and 6-inch sizes. Then the slide on the cone distance gage is loosened, and the gage is placed on the arm with the bottom of the pointer at the outside edge of the gear. The slide at the top is again set so that the zero lines coincide, and this gage setting can be used for the remaining gears when the turret is at the root angle and the arm in about its mid-position. The backing gage *N*, see Fig. 1, is convenient for gears having a pitch angle of less than 45 degrees, which are usually called pinions. After setting the first pinion, the plunger of this backing gage is placed against the back angle of the pinion about half way down the tooth, and it is adjusted until the zero lines of the gage coincide. The gage is then used for setting all the other pinions, and when set in this way the pinions will run flush at the back angles, even though the outside diameters vary, provided the first pinion was correctly set. A gear of accurate outside diameter must be used for the first setting.

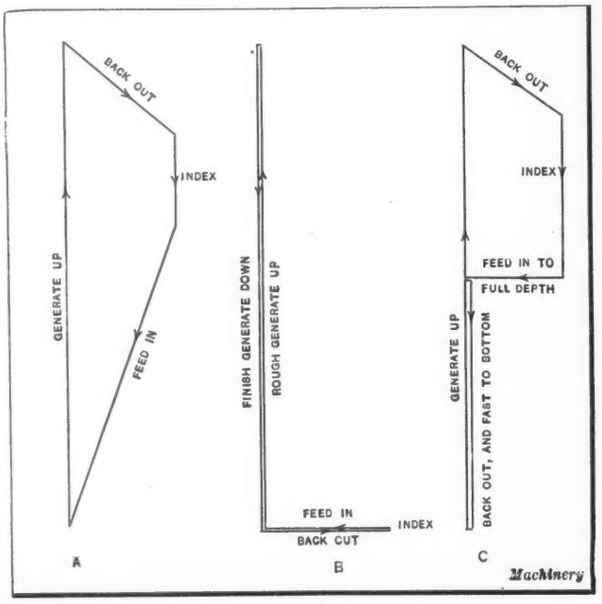


Fig. 4. Three Different Cycles of Movements employed on Bevel Gear Generators

Equalizing Stock Removed

The gear to be cut should be so adjusted that practically the same amount of stock will be removed from opposite sides of the roughly formed teeth. This is done simply by centering one tooth between the two tools. In order to turn the gear for centering a tooth, the clutch on the worm-shaft of the index mechanism is disengaged, and one half

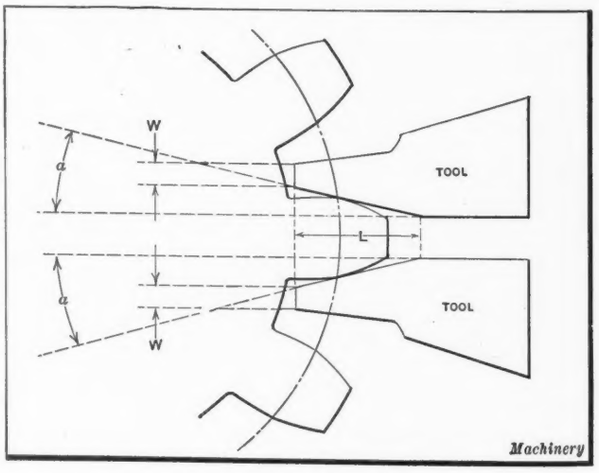


Fig. 5. Angles and Dimensions to be considered in selecting Tools

is shifted relative to the other half. The amount of adjustment is determined by starting the machine and then stopping it when the block angle (or dedendum angle) is at zero, as shown by the crown gear graduations, the cam-lever having been left in the mid-position on its jack, as when adjusting the work-spindle head.

With the crank-plate adjustment slot horizontal, and the crankpin at the forward end of its stroke, both the upper and lower tool-holders are shifted until the tools are about half way through the tooth spaces. Next, with the clutch disengaged, the indexing worm-shaft is turned with a crank until the gear tooth is in contact with the upper tool. A straight line is then drawn across the clutch sections with crayon or pencil. The worm-shaft is next turned in the opposite direction until the tooth touches the lower tool lightly, after which a line is drawn across one side of the clutch opposite the line previously drawn on the other side. The worm-shaft is now turned backward until the single line on one half of the clutch is midway between the two lines on the other half, thus centering the gear tooth between the tools. The clutch sections are then locked together.

After one gear has been set relative to the tools as just described, the stock dividing gage shown at *M*, in Fig. 7, may be used for locating all the other gears. This gage has a swinging pointer, the lower end of which is inserted between two teeth. The gage is set so that the zero lines at the top of the pointer coincide when the lower end is in a tooth space and touching both teeth.

The planing tools should have a cutting stroke equal to the face width of the gear plus ¾ inch, with an over-travel at the small ends of the teeth of about 1/16 inch. The tools are held in swinging clapper-boxes which provide relief during the return strokes and prevent the tools from dragging and becoming dulled rapidly. These clapper-boxes are returned to the cutting position by friction rods, which slide through adjustable friction boxes.

Time Required for Cutting Bevel Gears

The total time required for cutting bevel gears on generators varies considerably in different plants, because it may be affected decidedly by the method of roughing the gears, as well as by the material of which the gears are made. When gears are stocked out and finished on a generator, the cutting time is greatly increased, although this practice

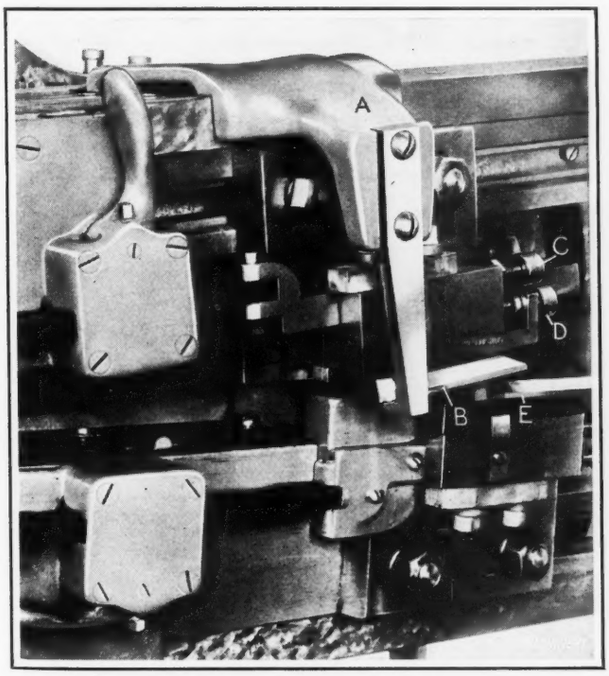


Fig. 6. Gage in Position for setting Upper Tool

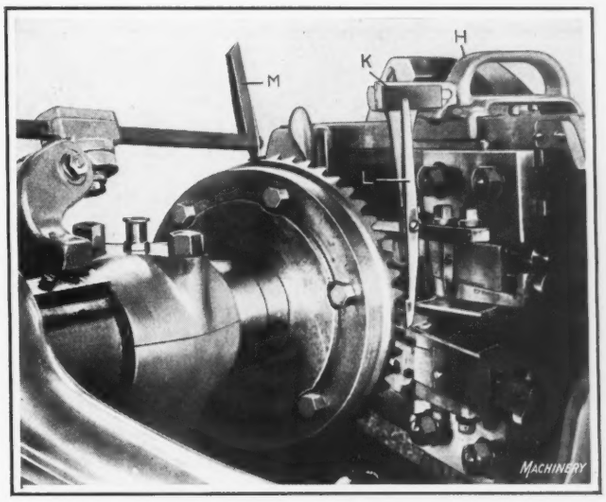


Fig. 7. Gages used for setting Gear in Correct Position for cutting

may be justified under certain conditions, as when gears are cut on a small scale. Even when gears are stocked out on other machines, the total cutting time for gears of a given pitch and material often varies widely, owing to the use of different types of machines. In the large automobile plants where work is done on such an extensive scale that the use of highly specialized roughing machines is warranted, the time for the roughing operation is a relatively small percentage of the total time.

In connection with cutting speeds, it is well to consider the relation between the speed and the period of effective cutter operation between successive grindings. Thus, when establishing an economical cutting speed, it is necessary to take into account the loss of production due to time required for changing cutters and the cost of grinding dull cutters, as well as the increased production obtained by higher cutting speeds.

The following rates of production representing the performance of Gleason generators are not given as records nor as examples that are considered unusual, but rather as average rates which have proved satisfactory in actual practice. These figures relate to the time required for finishing the teeth of gears that have been roughed out on other machines.

Rates of Production for Straight-tooth Bevel Gears

When using a 6-inch generator and cutting differential gears of 5–7 and 6–8 diametral pitch, the time per tooth usually varies from 12 to 15 seconds. In one instance the time for pinions having twelve teeth of 5–7 diametral pitch was 12 seconds per tooth, and the floor-to-floor time, 5 minutes. When using 11-inch and 18-inch generators for cutting steel gears, the rates for different pitches were as follows: 3 diametral pitch, 72 seconds per tooth; 4 diametral pitch, 60 seconds per tooth; 5 diametral pitch, 50 seconds per tooth; 6 diametral pitch and smaller, 36 seconds per tooth.

When cutting cast-iron gears, these rates vary as follows: For 3 diametral pitch, 60 seconds per tooth; 4 diametral pitch, 50 seconds per tooth; 5 diametral pitch, 42 seconds per tooth; and 6 diametral pitch and smaller, 30 seconds per tooth.

* * *

An international exposition of the mechanical and electrical industries will be held at Ghent, Belgium, from June to October, 1923. The exposition will be held in the buildings of the Ghent World's Exposition of 1913. It is planned to exhibit practically all classes of machinery, including machine tools, woodworking machinery, and industrial machinery in general. For information, address Comite de l'Exposition de 1923, Royal Casino, Parc, Ghent, Belgium.

Metal Spinning and Spinning Tools

By EDWARD HELLER



METAL spinning is employed mainly for two classes of work: (1) for removing wrinkles formed on shells during the drawing process, and (2) for producing shapes that are too difficult to draw by means of dies or that would cost too much when made in that way. Spinning to remove wrinkles from shells is by far the simpler of the two applications. Deep-drawn shells made of a comparatively light gage metal such as is used in the making of kitchen utensils and certain kinds of electrical goods, are hard to draw without wrinkling unless the part is cylindrical, and even cylindrical shells are at times slightly wrinkled. The quickest and cheapest way of getting rid of such wrinkles is by a spinning operation. Spinning lathes are made in various sizes for practically all kinds of "automatic" spinning, and as they are standard machine tools, a description is scarcely necessary. The tools used in spinning, however, are of interest.

Spinning Outfit for Removing Wrinkles on Steel Shells

A plain spinning outfit used for removing the wrinkles on a steel shell having a rounded bottom is shown in Fig. 3. The spinning chuck *A* is made from 0.85 to 0.90 per cent carbon steel, and the tail-piece *B* is an iron casting. Stem *C* of the chuck is of such size and shape that it is adaptable to many kinds of work and could well be adopted as a standard. The thrust bearing *D* supplied for the tail end could also be standardized, as it may be used with many classes of spinning tools. The bearing proper is held on the tailstock spindle by means of a set-screw. The tail-piece *B* revolves on a projecting stem to which it is held by a set-screw. The projecting stem is stationary, being a pressed fit in bearing *D*, and supports one race of the ball bearing provided in back of the tail-piece.

Spinning is done by means of the tool-steel roll *E* mounted on a hardened and ground shaft *F* which is a pressed fit in the roll and is provided at each end with a roller bearing in bushing *K*. This entire unit is held in the cast-iron holder *G* by two side plates *H*, which are fastened to the holder by means of flat-head screws. The diameter of roll *E* is usually about 5 inches, except when projecting flanges or other obstacles necessitate a larger diameter. The shank of the holder is about 2 inches square, and is finished on the top and bottom sides to insure a good bearing on the lathe carriage.

The space between bushing *K* and shaft *F* is entirely filled with rollers except for an allowance of about 0.001 inch between each roller for lubricant. The shaft and bushings must therefore be made to close dimensions. It is advisable to keep the rollers of a standard size, and so, obviously, the diameters of the shaft and the bushing on the inside will be decimal numbers. The proper shaft diameter can be quickly determined by making use of the formulas and tables of constants given on page 485 of MACHINERY'S HANDBOOK. Taking the bearing in question as an example, it was decided to use ¼-inch diameter rollers, and the requirements of the job necessitated that shaft *F* be at least 1 inch in diameter. By laying out the bearing it was found that sixteen rollers would be required to surround the periphery of a shaft approximately 1 inch in diameter. Then by using the formula for finding *R* on the page referred to, and using the constant given in the extreme right-hand column for sixteen rollers, it was found that the diameter of shaft *F* would be 1.0314 inches if the rollers touched one another. Next, allowing for a clearance of 0.001 inch between each roller, the actual diameter of the shaft would be

$$1.0314 + \frac{16 \times 0.001}{3.1416} = 1.0365 \text{ inches}$$

The amount of clearance should depend, of course, upon the size of the rollers, the speed at which roll *E* revolves, and the kind of lubricant used.

To make possible the use of a chuck similar to that shown in Fig. 3 on any spinning lathe, an adapter of the type illustrated in Fig. 4 should be furnished for each lathe. The

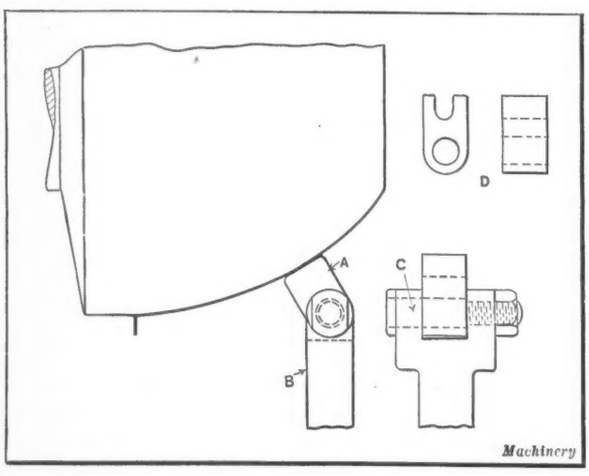


Fig. 1. Tool used for spinning Aluminum Shells

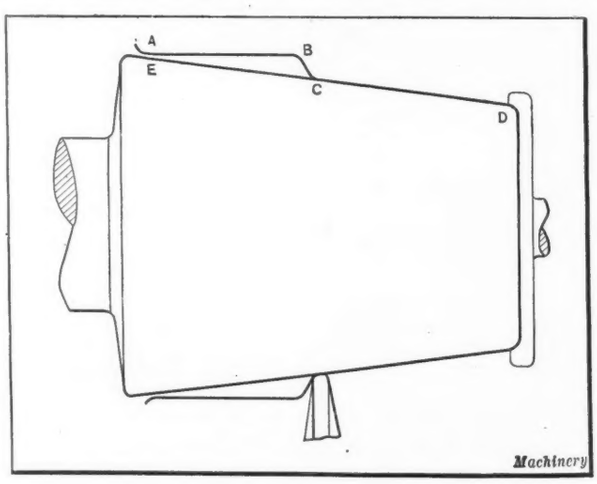


Fig. 2. Work that is partially shaped by Spinning

threads on the extending end of this adapter must agree with those in the head end of the chuck, while the threads in the tapped hole in the adapter should be made to suit those on the machine spindle. By increasing the length of the internally threaded end, the adapter may serve as an extension member.

Spinning Aluminum Shells

The tooling outfit just described is suitable for use in connection with steel shells only. The tools for shells made of aluminum or other soft metals are similar to those for steel shells so far as the chuck and tail-piece are concerned, but the spinning is done with a shoe instead of a roll. An idea of the way in which the operation is accomplished will be obtained by referring to Fig. 1. Shoe *A* is made of tool steel, and hardened. It is held in the jaws of the steel forging *B* by stud *C*. This stud allows the flat end of the shoe to remain tangent to the work at all times. At *D* is illustrated a shoe of recent development that is used on shells polished at some later stage. The first prong or tooth on the shoe that makes contact with the work smooths out the wrinkles, while the second, coming in contact with a comparatively smooth surface, acts as a burnisher.

Completing the Shape of Shells by Spinning

Fig. 2 shows how spinning may be done on water pails or other shells having the open end larger in diameter than the closed end. In drawing a long taper shell of this class it is often necessary to finish the shell partly in one of the operations, perhaps the third or fourth, and then completely finish it in another. The shell, when partly drawn, may follow the outline *ABCD*, and when it is finally drawn the outline may be as shown at *ED*. A shell of this type will wrinkle no matter how carefully the different drawing steps are proportioned, and therefore must be spun. If the preliminary and intermediate draws are so proportioned that the step *BC* is not more than about ½ inch high it is possible to eliminate the final draw by spinning the cylindrical part near the open end to the desired shape and dimensions after the wrinkles in the lower part of the shell have been smoothed out. This method not only eliminates the time required for an additional draw, but also saves the cost of a set of drawing dies.

In spinning to develop shapes that cannot be drawn readily or at a reasonable cost, the work is generally of the type

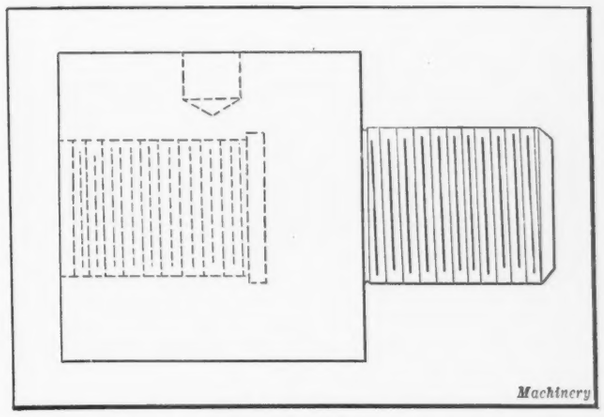


Fig. 4. Adapter which enables a Standard Chuck to be used on any Spinning Lathe

that is larger in diameter at the bottom, or some place intermediate between the bottom and the open end, than at the open end. One way of spinning such work is from the inside, in which case the operation really consists of stretching the metal. However, the general principles of spinning apply in these instances as well. Inside spinning is often resorted to when the difference between the largest and smallest diameters of the finished work is too large to enable spinning to be done from the outside. The shell is then drawn to a diameter about midway between the two extremes, and one section is spun from the outside while the other is spun from the inside.

Example of Inside Spinning

An arrangement of tools for the inside spinning of the lower part of a steel pitcher is shown in Fig. 5. The shell is held in an internal chuck *A* by a tail-piece *B*. The spinning is done by a small roll *D* mounted on a long stiff holder *E*. The holder is fastened to the top of the lathe carriage in the regular manner. Lubricant is supplied to the bushing of roll *D* through a hole drilled along the center of holder *E*, an oil-cup being located near the right-hand end of the holder. The work is shaped by spinning the metal against a large roll *F* mounted on a cast-iron bracket *G* at the front of the machine. The shaft of roll *F* is mounted in roller bearings. Bracket *G* is fastened to a stationary part of the lathe and should be doweled or tongued so that when it is removed it can readily be replaced in the proper position. This equipment can be used for a variety of shapes by simply changing roll *F*.

In designing tools of this class, care must be exercised to insure that there is sufficient space to permit roller *D* to be conveniently inserted and withdrawn from the work and to see that the roll is large enough to do the work efficiently. If the space allowed is too limited for the tool design described, one way of overcoming the difficulty is by using an arrangement similar to that shown at *X*. Here a plate *H* with a ball embedded in the center is substituted for the tail-piece *B*. One end of the offset holder *K* bears against this ball and holds plate *H* in place against the work, while the other end is connected to the tailstock spindle by a sleeve. With such an arrangement there is plenty of room to bring the

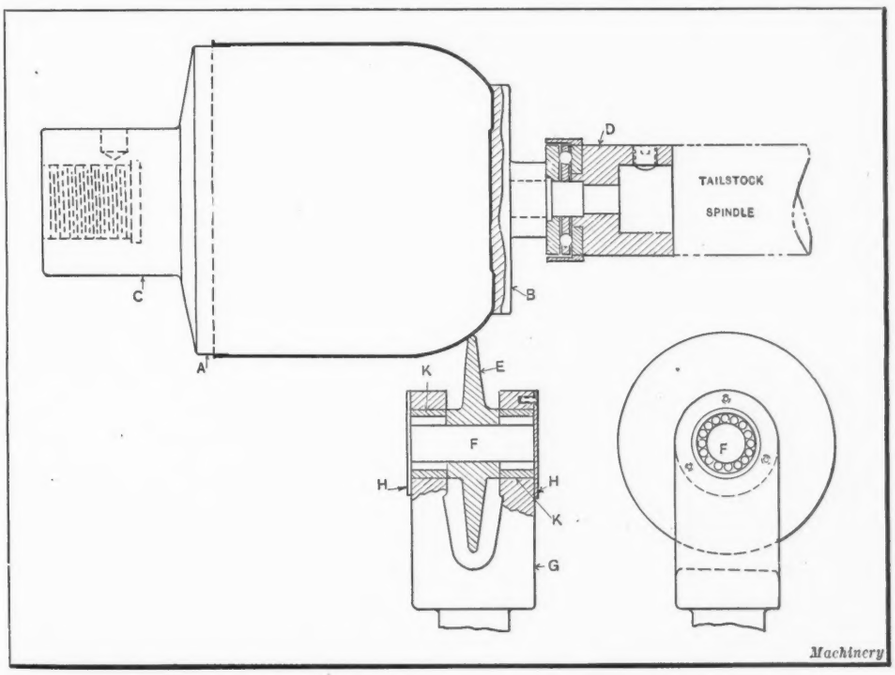


Fig. 3. Plain Tooling Equipment for removing the Wrinkles from Drawn Shells by Spinning

spinning roll against the inside of the work. The offset bar should be made of medium carbon steel and should be as heavy as possible; it should be hardened on the end bearing against the ball in plate *H*.

In using the tools in Fig. 5, roll *F* should be set up so that its axis will be parallel with that of chuck *A* and it should practically touch the chuck, as the slightest gap between the two members will cause pronounced marks on the finished work. This tooling is also intended for steel shells only. On aluminum work roll *F* will do more harm than good. For this reason the spinning of aluminum shells is performed without an outside support, the desired shape being produced by means of a cam. The screw in the cross-slide of the carriage is removed or released, and the slide linked rigidly to a roller or rollers traversing the guiding surface of the cam. As in the case of the roll bracket *G*, the member holding the form cam must be rigidly held to the machine, in such a way that an exact replacement is always possible.

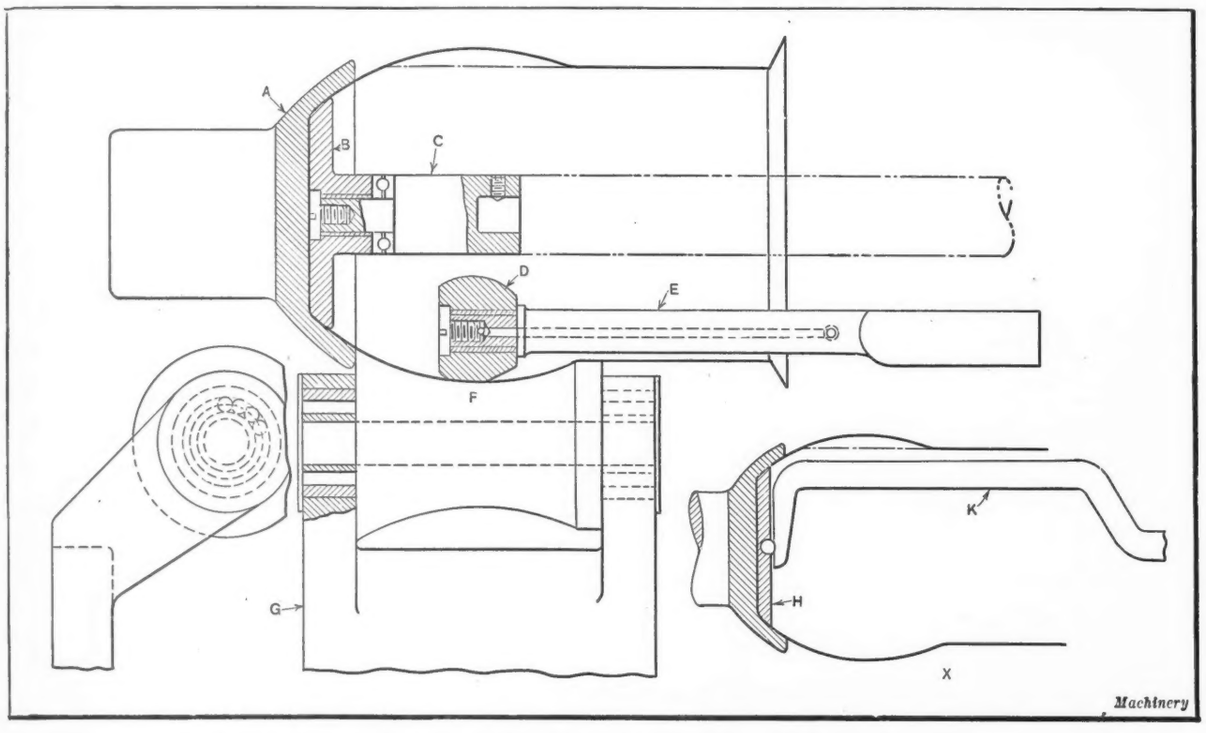


Fig. 5. Tooling Arrangement for Spinning the Lower Part of a Steel Pitcher from the Inside

Bulging the Open End of a Shell

Another application of internal spinning may be made in cases where one part of a shell is to be bulged out as shown in Fig. 6. It will be seen that the shell is held in a pot chuck *A*. The tail-piece has a live part *B* which revolves with the chuck, and a stationary part *C*, which is fastened to the tailstock spindle. A ball bearing *D* is placed between the live and stationary parts, and these two parts are held together by a screw that engages the threads of a tapped hole in the end of a stem on part *C*. The head of the screw seats against the end of the stem and allows part *B* to revolve freely on the stem.

The bulging is done by a roll *E* mounted on a crankshaft *F*, which is swiveled by means of handle *G*. The crankshaft and roller can be made to such dimensions that the work will be finished to the desired diameter when the highest point of the crank is brought directly toward the work, in which position an additional pressure on the handle will move the roll away from the work. On the other hand these parts could be so arranged that the entire throw of the crank is not utilized in producing a bulge of the desired diameter, but then it becomes necessary to provide an adjustable stop on part *C* for the handle to prevent too great a diameter of the bulged section. The first arrangement is more customary, as it enables a uniform product.

Different shapes and diameters of bulges can be formed by changing roll *E* to suit. The tail-piece *C* should be attached in such a manner to the tailstock spindle that convenient operation of handle *G* will be possible. A peculiarity found in work of this kind is that the open end of the shell becomes smaller in diameter after the bulging operation. This fact must be carefully considered in designing the tools.

Principle of True Spinning

Thus far the spinning tools described have been used for either smoothing out wrinkles or for stretching the metal, and while these operations may be classed under the general heading of "spinning," they are not true examples of spinning. The principle of true spinning is illustrated diagrammatically in Fig. 7. A cylindrical shell having the outline *ABCD* is required to be spun to the conical shape *EBCF*. To produce this shape, the spinning roll *H* is first pushed over the spinning chuck *I* along the line *BG* until a dent is made in the shell that resembles a saw tooth. The depth to which this dent can be made depends on a number of conditions, including the diameter of the shell after the final drawing operation, and the gage and quality of the metal from which the shell has been produced. A few trials will suffice to determine to what depth the dent should be made. When point *G* has been reached, the roll is traversed by means of the lathe carriage parallel to the center line of the work, that is, along line *GJ*.

After the work has been shaped along this line, the spinning roll is returned to point *G* and manipulated along line *GK* until another saw tooth has been produced, after which the roll is traversed along line *KL*. This process is repeated until the spinning roll reaches point *E*. Finally, the spinning roll is returned to point *B* and fed the entire distance along line *BE* in order to smooth the conical surface produced by the preceding steps. One of the absolute requirements of such work is that edge *A* of the shell rest slightly on the shank of the chuck so as to form a support while the first notch *BGM* is being formed. After that step there is a sufficient flange formed by the spinning to support the work firmly throughout the remainder of the operation.

Fig. 8 illustrates the method of spinning a tapered shell intended for use as a coffee pot. The completed shell is represented by the heavy solid line and the preliminary shapes by the dotted lines. This method is known as "offset" spinning. Chuck *A* is made of 0.90 carbon steel and is formed to the shape of the finished part, with the diameter *BC* of the large end slightly smaller than the diameter of mouth *DE* of the work. The tailstock of the lathe is moved off center a distance *FG*, so as to be in line with the center of the shell when the latter is in contact with the front end of the spinning chuck. A plate *H*, ¼ or ⅜ inch thick, is placed at the bottom of the shell prior to mounting the shell on the chuck. This plate fills the bottom of the shell and forms a support over this entire end. The plate is made in two halves which have the corners *J* cut away to facilitate their removal from the shell after it has been spun down.

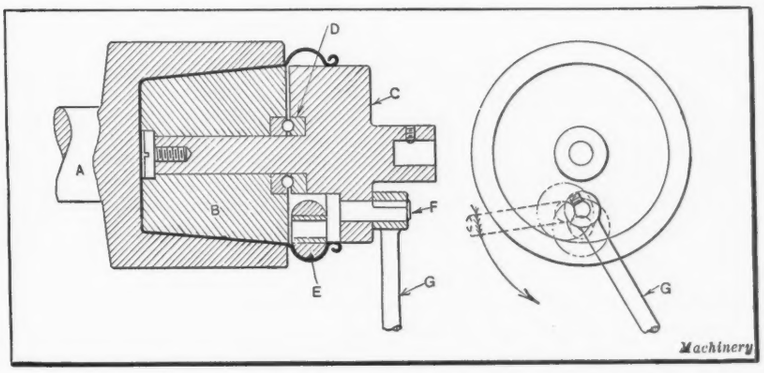


Fig. 6. Producing a Bulge near the Open End of a Drawn Shell

In order to have edge *K* of the shell supported by the shank of the chuck, the diameter of the chuck shank must be about the same as diameter *BC*. This is an instance in which a standardized chuck might not be convenient, at least not so far as the large diameter is concerned. The tail-plate *L* is of a standard type; it consists of an iron casting, held on a thrust bearing of the style shown in Fig. 3. When the difference between diameters *CM* and *DE* is a trifle larger than can be spun down successfully under average conditions, and when the quantity of work warrants it, the spinning operation may be facilitated by a preliminary shaping of the work, as shown at *N*, with an expanding die. Shells from 4 to 6 inches in diameter, when annealed after the final draw, can be expanded about ½ inch on a side or 1 inch in diameter without difficulty.

"Hot" Offset Spinning

A modification of offset spinning is "hot" offset spinning; this method is resorted to when the difference between the largest and smallest diameters of the finished work is great, and the length of the shell comparatively short. Fig. 10 shows this method applied to the spinning of a large steel tea kettle, and it will be seen that it is quite similar to the method shown in Fig. 8. In this case, however, a semicircular gas burner *A* has been added to the equipment. This burner is made of cast iron. It is about 2 inches deep radially and of a width to suit the work. The interior is cast hollow to form a chamber for the gas and air, which is admitted through a 1¼-inch pipe screwed into the tapped hole *B*. The face of the burner next to the shell is practically covered with holes 3/64 inch in diameter, spaced from ⅜ to ½ inch apart. The inside radius of the burner should be about 1 inch larger than the outside radius of the drawn shell.

The chuck is made in four parts, shank *C* being made of machine steel and the forming end *D* of 0.90 per cent carbon steel. End *D* is made hollow so that it will not conduct the heat away from the shell too rapidly; this construction also reduces the weight hanging on the connecting stud *E*. Stud *E* cannot be hardened, and so is made of a high-grade tough steel. The end cover *F* is also made of carbon steel. Both cover *F* and plate *H* can be replaced as they become worn, but the cover can be shimmed up and refaced a number of times before replacement is necessary.

The method of attaching the burner on the spinning lathe is represented diagrammatically in Fig. 11. The burner is held on bar *A*, which, in turn, is fastened to a horizontal rod supported in bearings *B* close to the floor. A foot-lever *C* and a second lever having a counterweight *D* are mounted on this horizontal rod. The air and gas lines are brought close to the burner, and are connected to it through flexible hose. Shut-off cocks are placed in a convenient position for the operator.

While the operator is placing a shell on the chuck, the burner is held in the position indicated by the dot-and-dash lines by the action of counterweight *D*. When he has finished putting the shell in place, he brings the burner into the working position by depressing foot-lever *C* and securing it under a hook fastened to the floor; this counteracts the tendency of weight *D* to swivel the horizontal rod. The gas and air are then turned on sufficiently to produce a good blue flame. After revolving the work a short time, it becomes red-hot and remains so until the flame is turned off at the end of the operation. The final smoothing-out touches are given to the work after it is again cold.

The limiting factor of hot offset spinning is the difference between the maximum and minimum diameters of the fin-

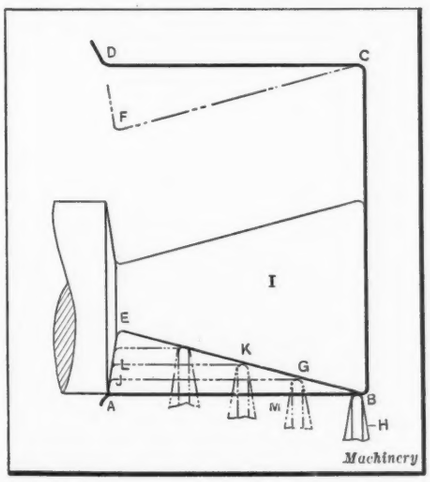


Fig. 7. Principle of True Spinning

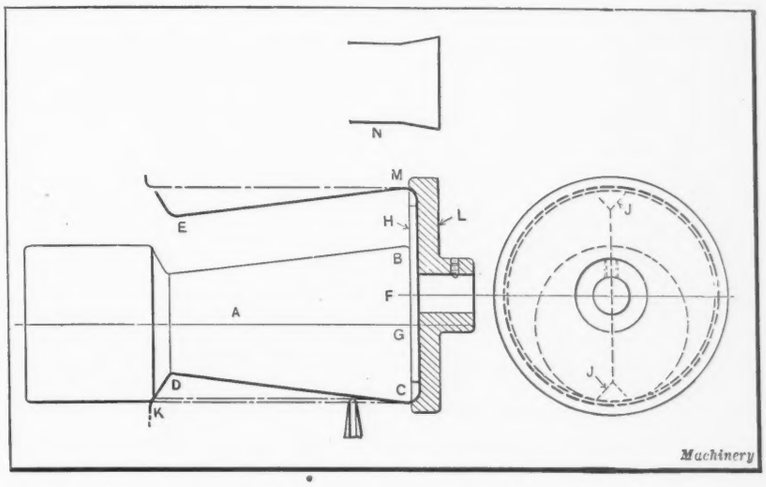


Fig. 8. Arrangement employed for an "Offset" Spinning Operation

ished part. Since the largest diameter of the chuck member *D*, Fig. 10, must be slightly smaller than the smallest diameter of the finished work, and its shape must be similar, it is obvious that if the difference in the diameters mentioned is great, the diameter of stud *E* may be so small that the stud will not have sufficient strength to sustain the job. The smallest diameter of neck that has been found in practice to give satisfactory results is about 1 inch.

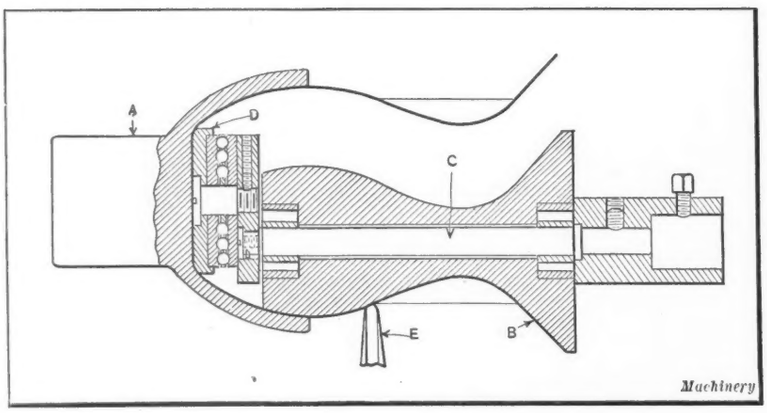


Fig. 9. Spinning a Pitcher by supporting the Form Roll on the Tailstock

Supporting Spinning Form by Tailstock Spindle

Another offset spinning operation is shown in Fig 9. This differs from the others that have been dealt with in that the spinning form is mounted on the tailstock spindle. The headstock spindle is again utilized for driving the shell through chuck *A*. This operation is the second one performed on the water pitcher, the first operation on which was shown in Fig. 5. Tools of the type used in Fig. 9 are employed when the shell is rather long, and consequently the driving means must be positive. The details of construction were decided upon after many trials and tests. The chuck is made of cast iron and the form roll *B* of chrome-nickel steel. The roll is provided at each end of its bore with a roller bearing, the inner race of which seats on the round bar *C*. On the left-hand end of this bar is mounted a member that supports a ball bearing having three circles of balls, so that the revolving work and tail-piece *D* have no effect on the supporting arrangement. The spinning operation, of course, is accomplished by the spinning roll *E*.

* * *

SAVINGS BY RECLAIMING SCRAP

In June MACHINERY an article appeared on the savings made possible by reclaiming a railroad scrap pile. Such reclamation work has proved to bring about considerable savings in other shops as well. The savings naturally vary with the prices of new material. In 1920, when new materials were at peak prices, the savings were the greatest. At the present time, when prices of new materials are considerably reduced, the percentage of savings is evidently much less; nevertheless, a material saving can be obtained by a careful study of the possibilities of reclaiming scrap. When prices were at their peak, the savings in some cases amounted to as much as 75 per cent of the cost of new equipment. In other cases the savings would be only from 15 to 30 per cent, according to the character of the reclaimed article. A material saving as a rule, can be made in the reclaiming of couplings and nipples, where the cost of new material would be comparatively high but the reclaiming cost almost nominal. Hand-trucks, wheelbarrows, and wrenches also present good opportunities for savings by reclaiming. The same is true of couplers, brake-beams, and springs. The important point to observe is to study the cost incident to reclaiming the article, so that more is not spent in trying to save the article than would be involved in the buying of a new part or tool. This mistake is frequently made, and in that case the apparent saving is turned into an item of expense.

* * *

RUSTLESS IRON

A material known as rustless iron, which is said to be suitable for machine construction, has been developed by J. J. Saville & Co., Ltd., Sheffield, England. This rustless iron can be bent cold to an angle of 180 degrees without fracture. The metal is said to take a polish equal to that obtained on electroplated surfaces, and to resist rust or tarnishing without any further attention. It is pointed out that it may be useful for machine tool parts, which by reason of their contact with cutting compounds are subject to corrosion. The material can be cold-worked by stamping, pressing, rolling, drawing or spinning, and can also be drop-forged. The physical properties of the metal are said to be as follows: Tensile strength, 80,000 pounds per square inch; elongation, 25 per cent in two inches; reduction of area, 60 per cent; and a hardness on the Brinell scale equal to 150.

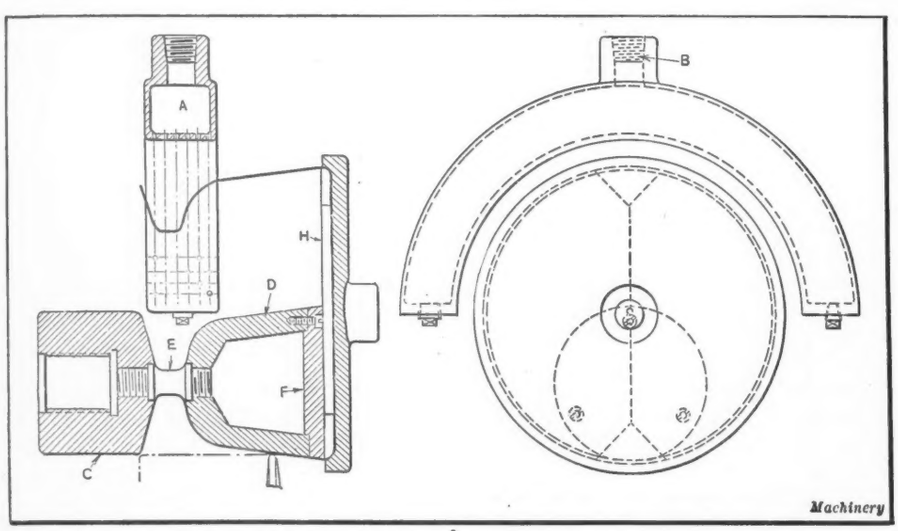


Fig. 10. Hot Offset Spinning Operation in which the Work is heated by Means of a Gas Burner

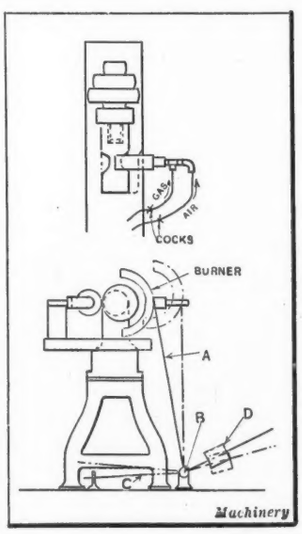


Fig. 11. Burner Arrangement

QUALITY AND COST OF RAILROAD REPAIRS

By WARREN ICHLER

Does the quality and cost of repair work turned out in the roundhouse and the railroad main repair shop today compare favorably with that of former years? It would be extremely difficult, if not impossible, to answer this question with a plain yes or no. The writer, himself a railroad machinist, asks the question not so much as an introduction to his own opinions, as to invite the expression of opinions from others who are interested in railroad repair work. If this question were asked at any gathering of railway mechanical officials, both affirmative and negative replies would doubtless be received. The affirmative replies might be expected mainly from the younger officials, who would naturally point out the high mileage and great tonnage records of modern locomotives as a proof of their assertion. Officials inclined to take the negative side of the question would probably cite the increased cost of roundhouse repair work as a basis for their claims. A little study of these methods of comparison will serve to show the fallacies of both.

Comparison of Past and Present Operating Methods

It is probably true that locomotives are making mileage and tonnage records today that are far beyond those achieved ten or twenty years ago; but the present-day locomotive is much better designed and runs over heavier and better rails and bridges than did its predecessors. Grading and ballasting have also been tamped more solidly each day by the heavy traffic. Then again, the locomotive generally receives more attention as regards feed-water treatment than was usual in the earlier days, and it is subject to more rigid inspection rules than it was twenty years ago.

Now, on the other side of the case, we cannot overlook the increasing cost of roundhouse or running repairs between successive shoppings of a locomotive, or general overhaulings of the boiler and machinery. At first thought it would appear that rising repair costs in the roundhouse are an indication of poorer work in the main repair shops, but this is not always true. The more rigid inspections already referred to would tend to increase greatly roundhouse maintenance costs. The fluctuations in the cost of labor and material are factors tending to disturb the uniformity of locomotive maintenance cost, and the "pooling" of engines might also be cited as a practice tending to send the cost of runing repairs skyrocketing. For the benefit of those who may be unfamiliar with this system of engine assignment, it might be noted that under this practice, all engines in freight or switching service are operated on the "first ready, first to go" principle, as distinguished from past practice, where each engine was assigned to a particular engineer and fireman.

This is cited as a cause of high maintenance cost, as it encourages the careless engineman to pass his errors of omission in the matter of lubrication, inspection, etc., on to other shoulders. Where responsibility can thus be shifted, a good deal of minor repair work is neglected, until finally more serious trouble results from this neglect and the engine has to be removed from service to receive so-called "heavy roundhouse repairs," which are of necessity more costly than similar work done in the regular repair shops provided with better facilities.

In an effort to find some reliable means of comparing present-day repair work with that of twenty years past, the writer studied the matter on what might be called a "job for job" basis; that is, the method of handling each special repair job on a locomotive in 1904 was compared with the way such work was handled in 1922. In comparing present-day methods with those of the past, the writer has carefully selected examples that have come within his close personal observation. Only a few of the major operations involved in repairing a locomotive can be dealt with in a short article, but the ones selected are representative of common practice.

Counterbalancing Methods

The problem of counterbalancing naturally comes first as a basic matter in repairing or overhauling locomotives. By "counterbalancing" is meant the adding of weights to one side of a driving wheel to balance the weight of the side-rods, crankpins, and a portion of the reciprocating parts. Everyone is familiar with the solid segment of metal seen on locomotive driving wheels opposite the crankpin, and it is in this segment that the balancing weight is secured. Weight is added or subtracted from this segment, according to certain well-established formulas of design, by changing the volume of the lead cores. It was formerly common practice to test the static balancing of the driving wheels each time the locomotive was shopped for a general overhauling. Today this is rarely done, except when new driving wheel centers are applied. It is still the practice of one large western railway, however, to have the counterbalancing of every engine tested at each shop, but to the writer's knowledge, this is the only instance where this practice is adhered to. A somewhat extended inquiry into this subject served to verify this statement.

Setting Axles Parallel

Another fundamental operation in repairing locomotives is the adjusting of the shoes and wedges to insure parallelism of the driving axles, and to set the driving axles perpendicular to the longitudinal center line of the engine and track. The laying out, planing, and adjusting of these castings and their accessories, call for a high degree of skill, and in former years an error of 1/32 inch in the parallelism of the driving axles after the locomotive was remounted on its wheels, was deemed sufficient to justify a readjustment of the shoes and wedges, whereas an error of 1/16 inch receives scant attention in most shops at present. It may be noted here that the error in perpendicularity to the center line of the tracks generally causes rapid cutting or wearing of the driving wheel tires, while an error in counterbalancing is shown in the riding qualities of the engine and the rapid wear of the side-rod bushings or bearings.

Eliminating Needless Refinements

The writer has purposely refrained from mentioning such operations as the repairing of links and other valve motion parts where the old-time machinist gasps in horror over the present-day practices of peening, wedging, stretching, and twisting the various parts to the semblance of fits, instead of carefully fitting and polishing such parts. This omission is not referred to with the desire to sanction present-day practices or to deride the methods formerly employed. Doubtless many of these refinements were useless. A high polish on non-bearing surfaces never pulled an extra pound of freight a foot, and in many instances a good coat of paint would have served the purpose quite as well as a polished surface. However, somewhere between the extremes of the apparent carelessness of the present and the two expensive carefulness of the past, there must be a middle course which could be adopted, and undoubtedly some railroads are already following such a course.

The writer believes that the quality of repair work on locomotives has deteriorated in certain branches where it should not have been allowed to, and on the other hand there are some cases in which the elimination of needless time-consuming refinements have been a great advantage. With the rapid development of locomotives it is not to be expected that a progressive railroad official would feel it wise to spend large sums in costly repairs and refinements on his older equipment, when it may soon be retired from service. If, however, a clearly defined policy of lengthening the life of present equipment is decided upon, it is probable that there will be a return to the slower and more careful methods of previous years in handling certain classes of work. In fact, from the viewpoint of economy and good mechanical practice, such a course would prove necessary.

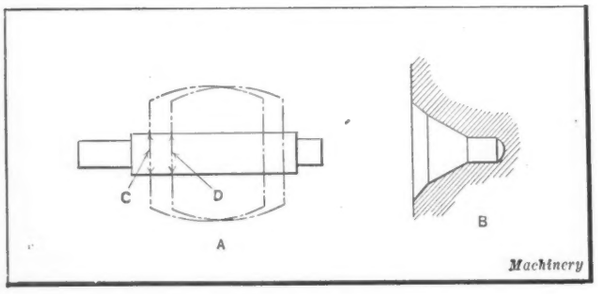


Fig. 1. (A) Diagram illustrating Extreme Positions a Part may occupy on an Arbor; (B) Economical Method of making Centers

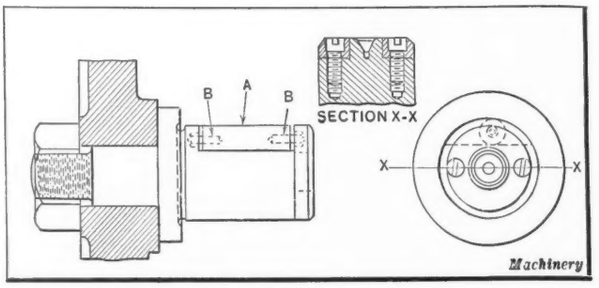


Fig. 2. Quick-acting Type of Arbor on which the Work is securely clamped in Place by Means of a Roller

DESIGN OF WORK-HOLDING ARBORS

By H. P. LOSELY, Industrial Engineer, Detroit, Mich.

Work-holding arbors are generally tapered 0.006 inch in diameter per foot of length, this amount permitting the piece to be held satisfactorily without requiring an excessive pressure to force it on the arbor, thus eliminating distortion and misalignment of the work. The amount of taper may be increased when there is no great demand for accuracy. In designing an arbor for a special job, attention should be given to the maximum and minimum diameters allowed for the hole in the work at the time the latter is to be put on the arbor. The points along the length of the arbor at which the work will be a pressed fit should also be calculated. In Fig. 1 at *A* the two points between which the left end of the work will always be located are indicated by dimensions *C* and *D*. Care should be taken to make the arbor long enough so that it will accommodate the piece in either of the two extreme positions.

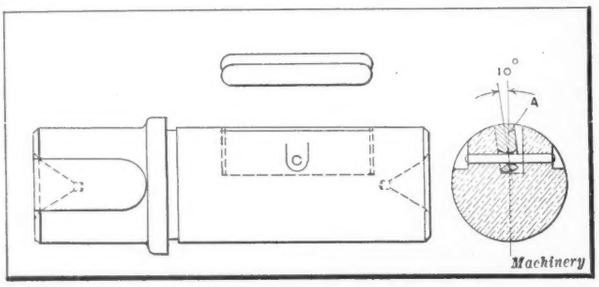


Fig. 3. Another Quick-acting Arbor having a Swiveling Leaf for clamping the Work

In order that the large end of the arbor may be readily distinguished, it is customary to make the turned down portion at this end longer than at the small end and also to provide a flat on the large end for the set-screw of the lathe dog. The ends of the arbor should be hardened, and the centers in the ends lapped to fit 60-degree lathe centers. It is customary to counterbore each center in order to prevent the edge from being damaged; this is more economically accomplished by countersinking with a 90-degree countersink as illustrated at *B*, Fig. 1, or with a center drill. If the tolerance on the work is large, or if it is desired to bring each piece into the same longitudinal position on the arbor on account of the setting of tools on the machine, a properly designed expanding arbor should be employed. Some excellent examples of expanding arbors are given in the chapter on arbors in a book entitled "Tools, Chucks and Fixtures," published by MACHINERY.

Types of quick-acting arbors which are very useful for facing operations are illustrated in Figs. 2 and 3. With the arbor shown in Fig. 2, the work is slipped on and then turned backward a slight amount, the result being that roller *A* is given a slight movement permitted by the size of the holes in which the outer ends of pins *B* are contained. This movement of the roller causes the work to be clamped securely in place. The tool is then fed in, and when finished the blank can be quickly pulled off.

Leaf *A*, Fig. 3, functions similarly to roller *A*, Fig. 2. The leaf in Fig. 3 should be ground while in the position shown. It is, of course, evident that in each case the clamping action of the roller or leaf forces the work into a slightly eccentric position, and therefore this type of arbor can only be used for facing or roughing operations. The arbors are also limited to work where the cut is continuous, as an intermittent release of the cutting pressure, such as occurs in facing gears, is liable to release the roller or leaf and allow the arbor to turn free in the part. However, in their limited field these arbors are great time-savers, being particularly suitable for such work as the facing of gear blanks.

Knock-off arbors for threaded parts are shown in Figs. 4 and 5. The one shown in Fig. 4 is of a common type, collar *A* being provided with lugs to facilitate its rotation relative to the arbor, when an operation has been completed. The collar on the arbor in Fig. 5 is provided with a flange having two recesses instead of the customary lugs. This is a safety feature, which has been adopted to reduce the likelihood of injury to an operator.

* * *

The total number of motor vehicles in France increased from about 100,000 in 1913 to 208,000 in 1921. Of these 93,000 are commercial vehicles. The number of commercial vehicles in 1913 was only 8000.

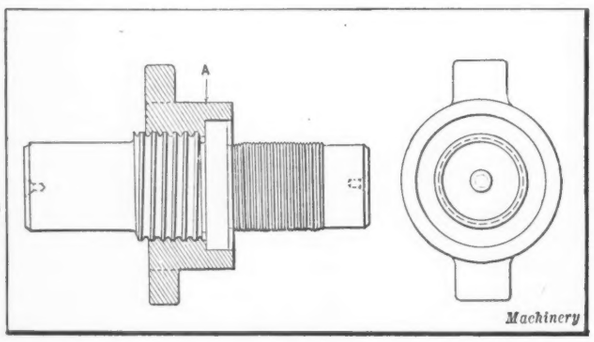


Fig. 4. Common Type of Knock-off Arbor applicable to Threaded Work

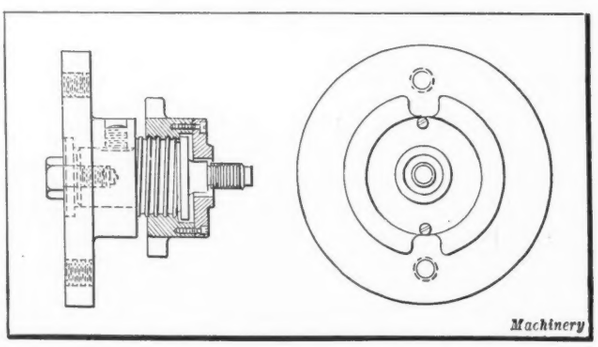


Fig. 5. Knock-off Arbor designed to reduce Danger of Injury to the Operator

Grinding Wheel Nomenclature

By H. A. PLUSCH, Plant Manager, Precision Grinding Wheel Co., Inc., Philadelphia, Pa.

Only two groups of artificial abrasives are used in the production of grinding wheels—aluminum oxide and silicon carbide—but different trade names have been adopted by individual manufacturers to distinguish their products from others. This practice has resulted in much confusion among grinding wheel users. The present article points out to which of the two groups well-known makes of grinding wheels belong, and explains the meaning of terms that are commonly used by ceramic engineers, but that are not always clear to the grinding-wheel user.

GRINDING wheel nomenclature is a source of perplexity to many users of grinding wheels who are not familiar with the processes followed in their manufacture. This confusion, to a large extent, is due to the fact that different trade names are used for wheels made from the same class of abrasive and the same or different symbols are employed to designate wheels of supposedly the same grade. Grinding wheels are made from both natural and artificial abrasives, the chief natural abrasives being emery and corundum. The value of the natural abrasives depends upon the percentage of crystalline aluminum oxide which they contain. Emery has a large percentage of non-cutting elements, and for that reason is used comparatively little in machine grinding. This abrasive in its natural state is in a crystalline form, whereas artificial or synthetic emery (aluminous abrasive) is crystallized in the electric arc furnace.

Artificial Abrasives

Artificial abrasives are produced in electric furnaces either from bauxite or from a mixture of coke, sand, salt, and sawdust, of which the chief constituents are coke and sand. Bauxite is a soft earth, and is the purest form of aluminum oxide found in nature. The oxide crystallizes when bauxite is fused in the electric arc furnace, and because of the abrasive being artificially produced, undesirable elements can be eliminated. It is due to this fact that artificial abrasive wheels have become popular.

Crystalline aluminum oxide ranges in color from white to deep wine color. Wheels made from this abrasive are recommended for grinding materials having a high tensile strength, including the various steels, annealed malleable iron, wrought iron, tough bronzes and tungsten. The trade name "Hy-Tens" given to wheels of this class manufactured by the Precision Grinding Wheel Co., Inc., conveys an idea of the materials that the wheels are intended for. Aluminum oxide grains are hard, tough, and dense, and when fractured leave sharp cutting edges.

The abrasive produced from the coke and sand mixture is known as silicon carbide, and ranges in color from green to a bluish black. The electric resistance furnace is used in its production. Wheels made from this abrasive are more efficient for grinding materials of low tensile strength, such as soft brasses and bronzes, cast and chilled iron, aluminum, copper, marble, granite, leather, and other non-metallic substances. The trade name "Lo-Tens" has been given to silicon-carbide wheels manufactured by the Precision Grinding Wheel Co., Inc. The accompanying table lists the names given by various companies to the aluminum-oxide and silicon-carbide grinding wheels of their manufacture. Silicon carbide is the harder of the two abrasives, but it is quite brittle.

TRADE NAMES GIVEN TO ARTIFICIAL ABRASIVES USED IN THE MANUFACTURE OF GRINDING WHEELS

Manufacturers	Aluminum-Oxide Abrasives	Silicon-Carbide Abrasives
Abrasive Co.	Borolon	Electrolon
American Emery Wheel Works	Corundum	Carbolite
Bridgeport Safety Emery Wheel Co.	Carbo-Alumina	Silexon
Carborundum Co.	Aloxite	Carborundum
Cortland Grinding Wheels Corporation	Oxaluma	Carbora
Detroit-Star Grinding Wheel Co.	Staralox	Staralon
Maxf Grinding Wheel Corp.	Sapphite	Carbo
Norton Co.	Alundum	Crystolon
Precision Grinding Wheel Co., Inc.	Hy-Tens	Lo-Tens
Safety Emery Wheel Co.	Rex	Corex
Sterling Grinding Wheel Co.	Sterlith	Sterbon
Vitrified Wheel Co.	Borofied	Carbofied
Waltham Grinding Wheel Co.	Alowalt	Carbowalt

Machinery

Bonding Processes

The color of both aluminum-oxide and silicon-carbide grinding wheels depends on the material used to hold the abrasive particles together, which is termed the "bond." The exact shade, however, is likely to vary somewhat with wheels of the same bond that are produced in the same heat, and so a slight variation in the shade of two wheels does not necessarily indicate a difference in grade. The four most important bonding processes are known as the vitrified, silicate, elastic, and rubber processes, and these names are applied to the grinding wheels produced by them. The use of different bonds permits the manufacture of wheels of different characteristics to suit all classes of grinding. Vitrified wheels are standard for most grinding operations, the other kinds being used when special conditions are encountered. Probably 80 per cent of all grinding wheels are vitrified. The bond used in this process consists of mineral and clay mixtures, which are fused at a high temperature, either to a glass or a vitrified matrix.

Silicate wheels are bonded by a mixture of minerals and silicate of soda or water glass, and baked at comparatively low temperatures. The wheels made by this process are also known as semi-vitrified. They are superior for tool and similar grinding where only a small amount of material is removed. On account of generating less heat, the danger of drawing the temper from a tool is minimized. Elastic wheels are bonded with shellac and other ingredients, and baked at low temperatures. Wheels made by this process have considerable elasticity, and are suitable where thin wheels are required, or where a high finish is necessary.

Rubber wheels are bonded with special mixtures of rubber, and then vulcanized. Wheels of this class have substantially the same advantages as elastic wheels, except that they can be made harder and thinner to meet more severe conditions. Both elastic and vulcanized wheels are used for cutting off tubing, wire, thin sheets of steel or brass, and parts which are difficult to hold while cutting off with the commonly used tools.

Vitrified wheels can be readily distinguished from the other wheels by their reddish or reddish-brown color, and the clean ringing sound which results when they are tapped. Silicate wheels are easily recognized

by their light gray color. Elastic and vulcanized wheels are almost black, but they may be distinguished by their odor when subjected to the friction of a grinding operation or when a small part is burned. Elastic wheels emit an aroma, whereas rubber wheels give off the odor of burning rubber.

The grain or coarseness of a wheel refers to the size of the abrasive particles used in making the wheel. It is designated by the number of meshes to the linear inch through which the abrasive will pass. For instance, a 24-grain wheel is one made from an abrasive which will pass through a sieve having twenty-four meshes to the linear inch. Wheels may be made with the abrasive particles all one size or a combination of sizes. In designating a combination-grain wheel, some manufacturers use special numbers which represent the average grain size, and others give a number indicating the coarsest grain.

The term "grade" refers to the strength of the bond, or the tenacity with which it holds the abrasive particles in the body of the wheel while subjected to grinding pressure. The term has no reference to the hardness of the particles themselves. The grade is determined by pressing the beveled blade of a chisel-like hand tool into the side of the wheel and then giving the tool a turn or twist. The resistence to this twist indicates the grade of the wheel.

The grades range from extra soft to special extra hard. A soft grade designates a bond that breaks down rapidly in the grinding operation, and a hard grade, a bond that has a stronger hold on the abrasive particles. Letters of the alphabet and numbers, or a combination of both, are used for denoting the grade of wheels. Many manufacturers use the letter M to designate a medium-grade wheel, and preceding or succeeding letters to distinguish softer or harder wheels. While every manufacturer's grade M wheel is about the same, an allowance should be made for variations in manufacture. Different grinding results are often obtained by wheels of the same grade but different manufacture.

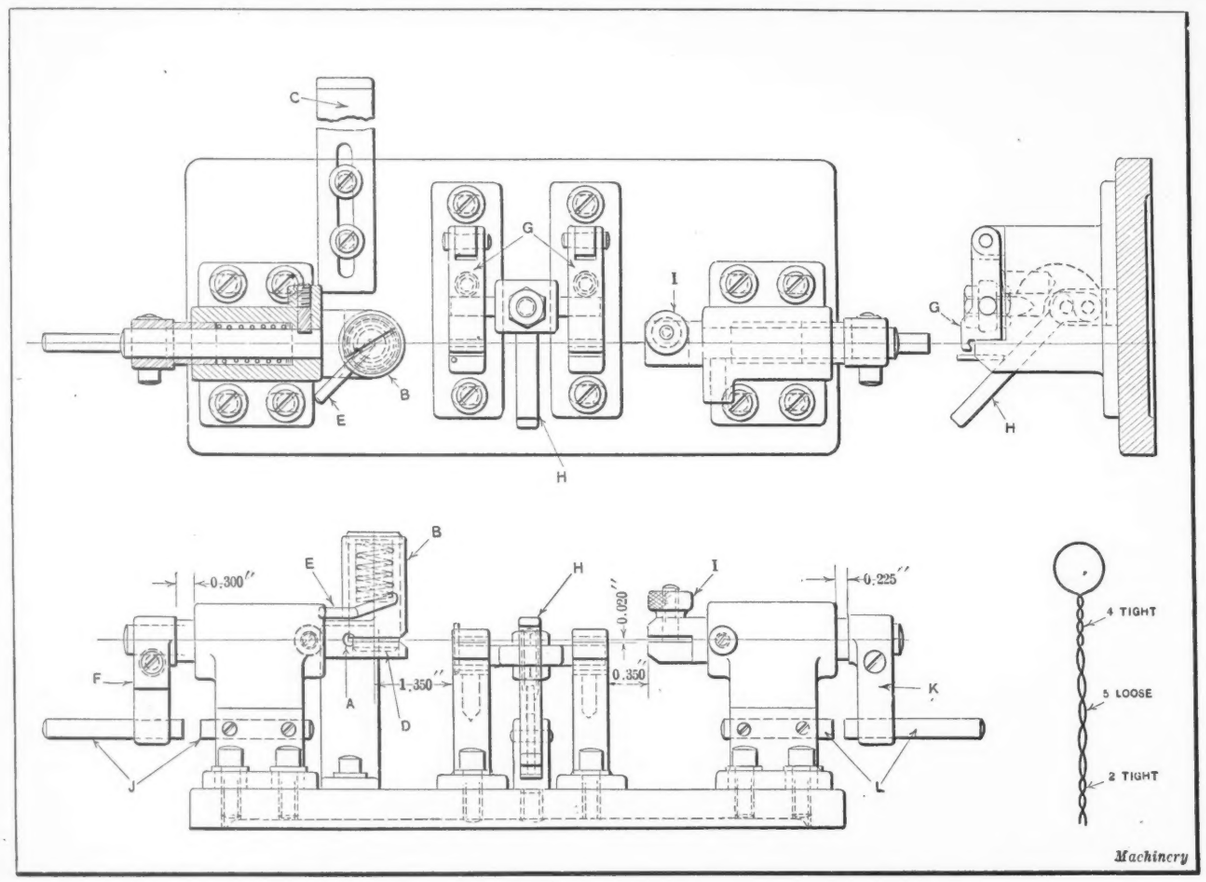
WIRE-TWISTING FIXTURE

By D. A. NEVIN

The accompanying illustration shows a fixture which may be used for twisting wire into various shapes. The design may be arranged for any desired length or number of twists to suit the requirements. The work (shown in the lower right-hand corner) is made from 0.030-inch diameter copper wire which has four tight turns at the loop end, two tight turns at the opposite end, and five loose turns in the center.

The wire is passed through hole *A* of the fixture, and the length gaged by the adjustable stop *C* at the rear. The middle portion is then looped around the stud *D*, which operates in post *B*, so that when pin *E* is turned in the cam-slot from which it projects, the stud will be raised sufficiently to permit the looped wire to be removed through the slot in the lower part of post *B*, which is an integral part of the spindle to which the crank-arm *F* is attached.

The wire, after being looped as described, is then swung around so that it may be secured by the hinged clamps *G* that operate in unison through the medium of the handle *H*, the manipulation of which actuates a link mechanism. The ends of the wire are secured in a clamp in the footstock by means of the knurled nut *I*.



Fixture for twisting Wire by Hand to form Piece shown in Lower Right-hand Corner

In making the piece shown in the illustration, the fixture is operated in the following manner: First the crank *F* in the headstock is turned to the right four turns, and then the stop-pins *J* are adjusted to engage at this point. This produces the four tight twists next to the loop. Then the crank *K* in the footstock is rotated twice, also to the right, to produce the twists in this end of the work. The stop-pins *L* are not adjusted at this time, however, for the five loose turns must first be made before these pins are set. The clamps *G* are next released so that the five loose twists may be made by turning the crank *K*. At the completion of this operation the stop-pins *L* are set. A fixture of this kind may be operated with speed after a little practice.

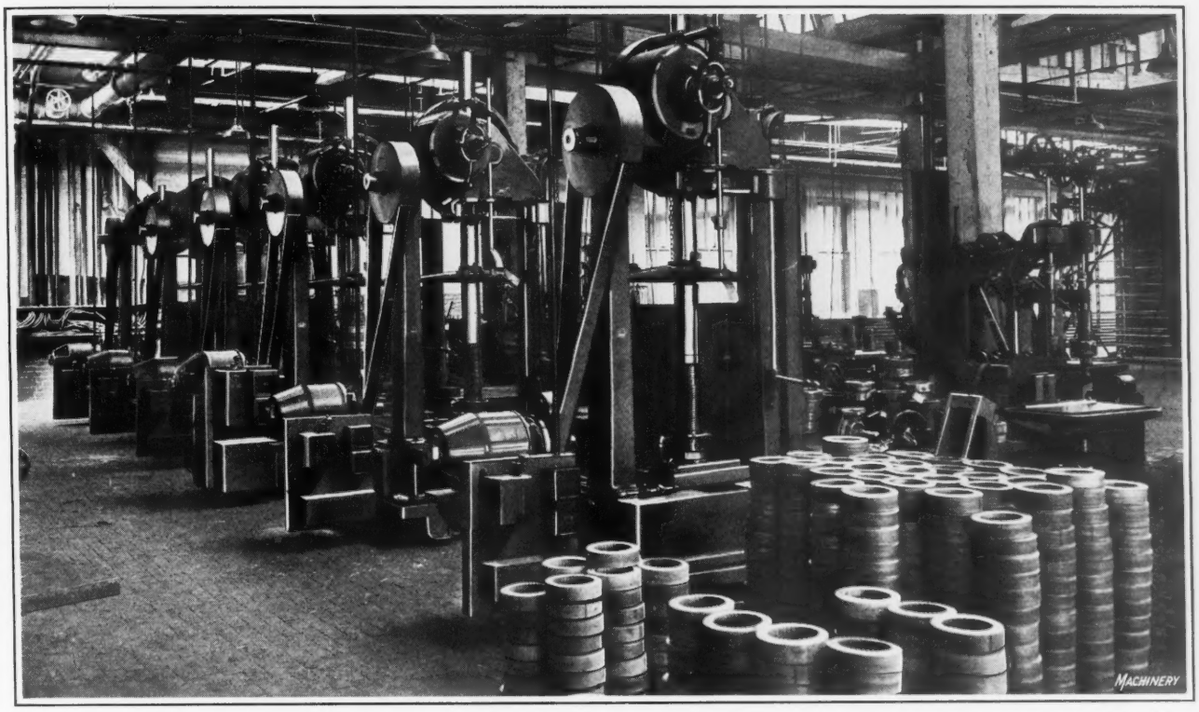


Fig. 1. Battery of Power Forcing Presses used in broaching Motor Stators

Broaching Stators on Forcing Presses

THE hole in assembled stators for electric motors is finished in the General Electric Co.'s plant at Rochester, N. Y., by broaching on Lucas power forcing presses, and the production obtained on this job is 550 stators for one operator per eight-hour day. For handling this work a battery of six of these presses is employed, as shown in Fig. 1.

A detail of the assembled stator showing the size of the broached hole is illustrated in Fig. 4. It will be noticed that the hole is held to a tolerance of 0.002 inch on the diameter. A close-up view of one of the presses set up for this operation is shown in Fig. 2, and the details of the section broach used may be seen by referring to the illustration Fig. 3.

The broach is made in seven sections, each having straight teeth, and these sections are assembled on a stem, which is screwed into the shank of the tool. The broach sections are held in place by a collar at the end, which acts as a pilot when the tool is in use. It has been found in this case that the straight-toothed broach gives more satisfactory results than a broach made of spiral-tooth sections, both of which have been tried on this job. After the broaching sections have been assembled, they are ground to a taper of 0.033 inch, starting with the second section from the end and extending to the last few teeth in the section nearest the shank, which have no taper. The design of this tool is such that in enlarging the diameter of the hole approximately 0.026 inch, each tooth takes a cut of about 0.001 inch. The broach is held in the spindle of the machine by means of a pin passing through the shouldered end, so that it may be removed, as is frequently necessary during the course of a day's work. Referring to Fig. 2, it will be seen that the fixture on which the stator is located is set on ground parallels which bring the face of the stator at right angles to the travel of the broach so that a true hole will be obtained. The fixture is counterbored to a slight depth on the top to accommodate the heads of the rivets by which the stator stampings are assembled.

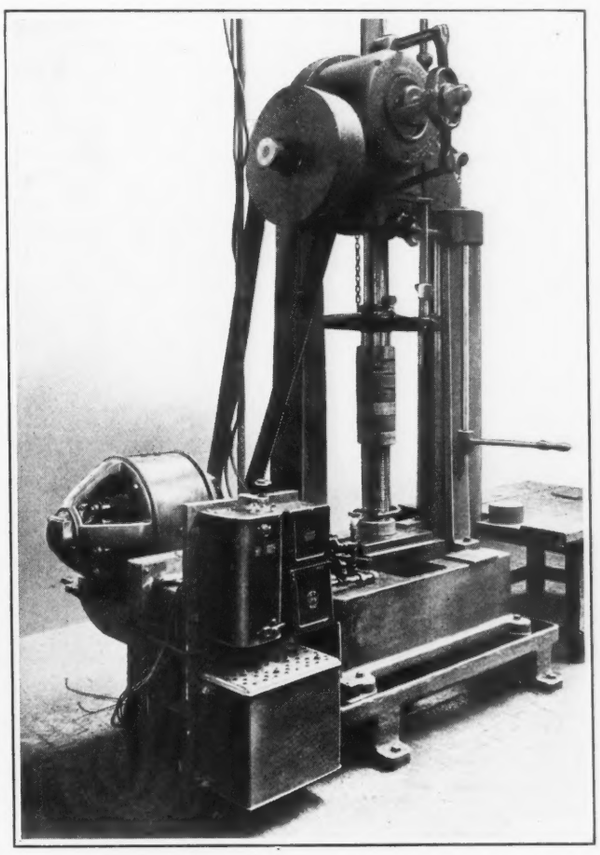


Fig. 2. Set-up of Forcing Press, showing Work and Broach

As the broach enters the stator it is guided by the pilot, and while it is passing through, the stator is advanced on the shank of the broach. This continues until the entire shank is loaded to capacity, as shown in the illustration. When eight stators are on the shank of the tool, the pin that secures the broach to the machine spindle is knocked out and the work

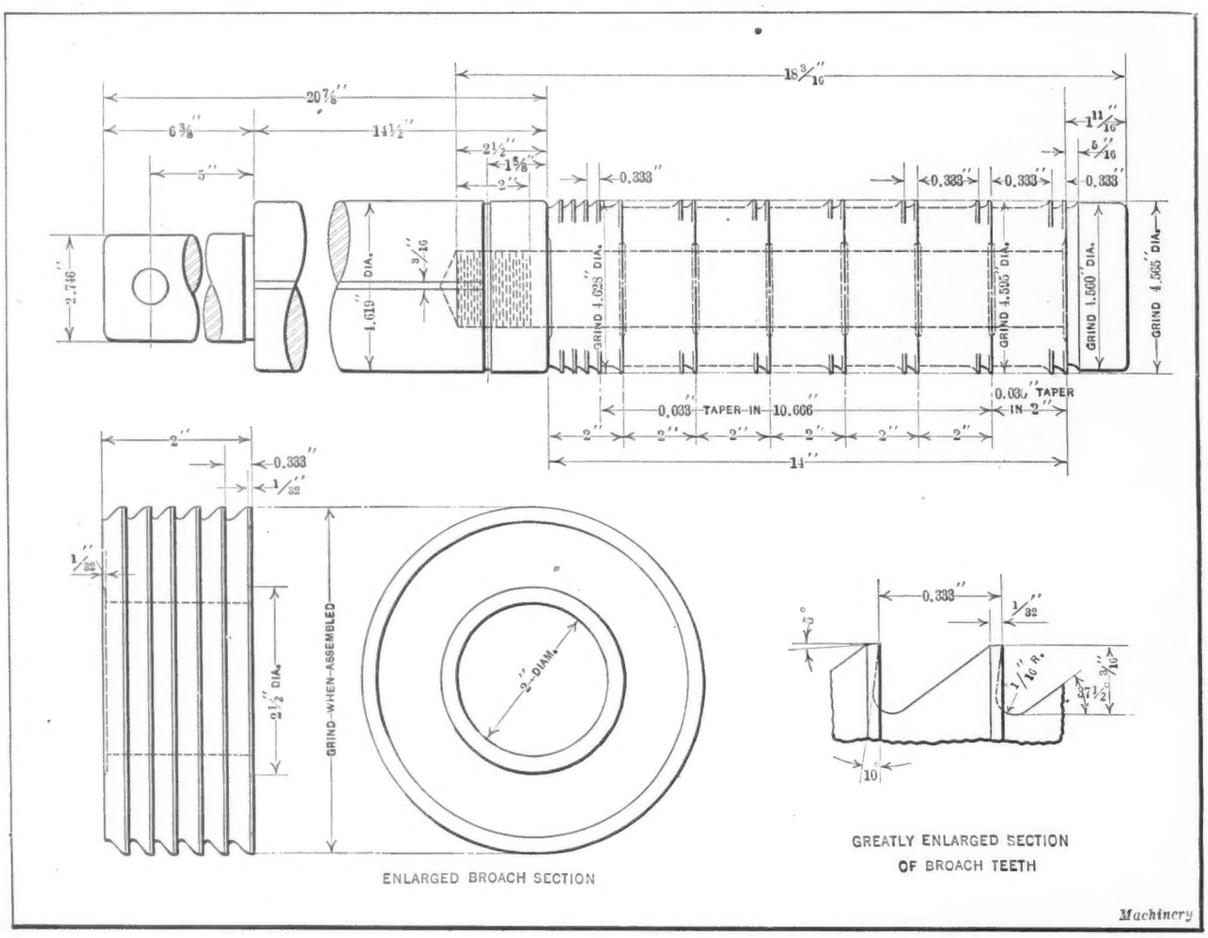


Fig. 3. Broach made in Sections, which is used in finishing the Holes in Stators

slipped off the end of the broach, after which the tool is again ready for use. It is of vital importance that the hole be broached square with the face of the assembled stator, as otherwise the outside diameter would not clean up when subsequently turned. The turning operation is performed on an Adams "Short-cut" lathe, and the work is held by air chucks.

The forcing presses are driven by a 10-horsepower motor which runs at a speed of 1150 revolutions per minute. The tool is lubricated and the chips washed from the teeth by two pipe coils, one above and one below the bolster plate of the machine. The inside of these coils is perforated so that a stream of cutting compound will be delivered to the teeth from above and the accumulated chips washed from the teeth beneath the work-holding jig after the broach has passed through.

These presses are of thirty-ton capacity, and there is a working space of 48 inches between the fixture and the end of the spindle in which the broach is fastened. Under the conditions stated, the broach will give good service for a week or ten days before it is necessary to regrind the teeth. As the larger sections are ground down and become too small for use in the same position on the tool, they are successively moved nearer the pilot end until they become too small for further use.

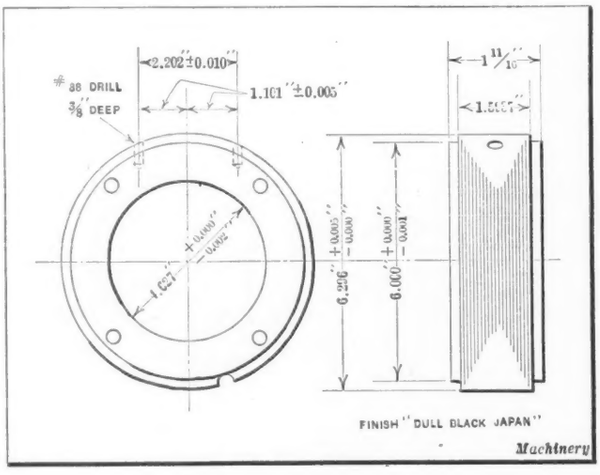


Fig. 4. Stator broached on Forcing Presses

AUSTRALIAN MACHINERY MARKET

The machinery market of Australia is dominated by the United Kingdom and the United States. Of the total imports in 1913, amounting to approximately $21,000,000, about $6,000,000 or 29 per cent came from the United States. By 1921 this had increased to about $16,000,000 or 43 per cent of the total, which was then $37,000,000.

German goods, excluded by Australian war-time legislation, may enter the field again next August. In 1913 machinery imports from Germany reached nearly $2,000,000 or 9 per cent of the total.

The growth in imports from the United States is remarkable in view of the advantages that are enjoyed in the Australian market by the United Kingdom, among which are: (1) substantially heavy preferential tariffs; (2) favorable exchange rates; (3) close political, commercial and financial affiliations. Many importing machinery dealers have intimate connections with Great Britain, some of them actually being branches of British houses. Many Australian industrial establishments are financed by British capital. Three leading banks in Australia are British and the rest have branches in Great Britain, but no American bank has been established there as yet.

The Machine Tool Trade in Japan

By YAMATAKE & CO., Tokyo, Japan

JAPAN buys all classes of machine tools—lathes, turret lathes, milling and drilling machines, gear hobbers and shapers, horizontal boring machines, planers, shapers, slotters, grinders of every description, electric and pneumatic tools, and many special machines. Machines are purchased in all sizes, from the bench lathe to the heavy gun turning lathe, and other machine tools in similar proportion. It is easier to say what machine tools Japan is not buying as yet, that is, machines for quantity production. In this respect Japan is far behind the United States, England, and the more progressive continental countries. A few branches of the Japanese industry have begun to use automatic and other special machines for quantity production, but very few factories have a production large enough to warrant the expense of installing special machinery of this kind.

In woodworking machines the staple types of band, circular and gang saws, planers, etc., form the bulk of the business, although there is some trade in special machines for certain industries.

The Government is the Principal Buyer

The most important buyer is still the government (Army, Navy, State Railways, etc.). The electric, shipbuilding, and general machine-building industries also are large consumers of machine tools. Of course there are numerous other buyers, such as bicycle makers, repair shops of the big sugar, paper, and spinning mills, and many others. The automobile industry is still in its infancy and is likely to be of slow growth. High production cost, a small market and oppressive taxation militate against its success.

The imports of metal-working and woodworking machines in 1920 were valued at 13,650,000 yen (approximately $6,825,000). In addition there is a home industry which in that year produced machines to a value of nearly 10,000,000 yen. The figures for 1921 are not available yet, but doubtless are much below these figures. During the present year, both imports and home production have receded further, as the Government is buying little, and only a few of the private industries are prospering.

American and British Exports to Japan

In 1920 the United States sent to Japan 10,964,000 yen ($5,480,000), and Great Britain 2,573,000 yen ($1,280,000) worth of machine tools. Import from other countries were insignificant in 1920, but now imports from Germany are appearing on the market again.

Where machines made in the United States are preferred, the makers have won this distinction through modern design, high-class workmanship, and honesty; but many manufacturers in the United States have hurt their reputations in Japan through poor quality of their shipments and disregard of contracts in past boom times. This class of manufacturers will find it difficult to reconquer the market when conditions are better again.

British machines are sold a good deal through force of habit. They were the first in many factories and have given satisfaction; thus the repeat orders go to England, even where other countries can offer better machines. It must be acknowledged, however, that the British machine tool industry is less self-satisfied and more progressive now than it was before the war. When business revives, England will probably put up a good fight for a larger share of the imports. Germany will gradually gain third place in imports, but for several years will lag a long way behind her two big competitors.

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO JAPAN IN 1921

Month	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
Jan.	$95,316	$87,432	$57,456	$240,204	$353,457	$593,661
Feb.	44,900	17,938	97,652	160,490	207,948	368,438
March	37,470	4,654	57,250	99,374	159,521	258,895
April	43,179	14,452	6,887	64,518	171,428	235,946
May	9,883	9,658	18,857	38,398	49,675	88,073
June	478	5,689	68,476	74,643	524,776	599,419
July	44,549	6,799	11,115	62,463	66,828	129,291
Aug.	1,320	6,346	7,028	14,694	36,787	51,481
Sept.	8,097	15,974	38,493	62,564	21,416	83,980
Oct.	6,846	11,398	16,767	35,011	26,698	61,709
Nov.	.....	8,225	23,578	31,803	33,748	65,551
Dec.	8,990	9,671	26,903	45,564	54,010	99,574
Total	301,028	198,236	430,462	929,726	1,706,292	2,636,475

Machinery

Advice of American Manufacturers

In order for American manufacturers to obtain greater trade with Japan they should heed the following advice, which they have heard often but have not always heeded:

1. If you want to do export trade, stick to it. If you intend to engage in export business only as a stop-gap when times are bad in the United States, you will be disappointed and will hurt the reputation of other manufacturers who want to stay in the export trade and treat foreign customers accordingly.

2. Follow the instructions of your buyers minutely even if you do not understand their necessity.

3. Pack twice as carefully as you would do for the home trade. Consider that the packages may be stood upside down for a five-thousand mile trip, and will be thrown about. Will they stand it?

4. Have some *responsible* man check the packing list. Better have it checked twice. A missing tool or cam may make the machine useless for many months, until replaced. Remember that the foreign buyer cannot get your shipping department over the long distance telephone and say what he thinks about its delinquencies, but he remembers your neglect and in the end *you* pay for it in loss of business.

5. If the machine you are selling is complicated and if you are in the habit of sending a mechanic to install it properly for the buyer, consider the position of your foreign buyer who probably has never seen such a machine and has nobody to advise him. Put yourself in his place and work out detailed instructions for his benefit. The same thing will help a dozen foreign customers who would otherwise have trouble and be dissatisfied with your product. Have these instructions made by your technical staff and thoroughly tested by persons not familiar with the machine. The specialist generally omits the most important point since it is an old story to him; but it is one which the buyer does not know.

6. Half of the machines received from the United States arrive badly rusted. This is probably due to the fact that a cheap "export" slush is widely used although it is well known that the best rust-preventing slush is barely good enough to protect a machine coming to the East in the rainy season. The manufacturer hurts his interest dollars for every cent he saves in using cheap rust preventives on his export shipments.

Inspecting by Optical Projection

SCREW thread elements, gear teeth, cutter forms and in fact any profile or contour may be accurately inspected by the projection of an image on a screen. This principle of inspection has been incorporated in several instruments for laboratory and commercial inspection work. The advantages of this method of inspection are rapidity and accuracy. Optical inspection instruments contain mainly a source of light, a system of lenses, and a surface on which the image may be cast. The surface or object to be inspected is placed in the ray of light, usually between two lenses of the optical system. The surface on which the image is cast is often a chart containing a master outline with which the projected image may be compared. This method of comparing the accuracy of contours is largely used in inspecting screw threads.

The application of this system of inspection is limited only by the size of the work and the area of the screen or chart on which the image is projected. Provided the magnification is definitely known it is even practicable to measure the image direct, so that in the case of the pitch of a thread, errors can be determined in terms of actual measurement. Ordinarily, however, the optical projector is used as a comparator.



Fig. 1. Adjusting the Optical Instrument for inspecting a Large Screw Thread

During the war, the Bausch & Lomb Optical Co., Rochester, N. Y., developed an optical instrument which proved so satisfactory for the company's own use that it is now being commercially manufactured. It is stated that when using this instrument as a thread comparator it is possible to inspect five hundred screws per hour for external, pitch and root diameter, thread shape, evenness of outline, angle, and width of flat at top and root. This instrument is also used for testing gears to determine tooth form and contact and for a great variety of formed work. The machine differs in two particulars from others in commercial use—first, in the optical system, and second, in the arrangement and type of the thread chart.

General Construction of the Optical Projector

The stand on which the instrument is mounted is furnished with casters so that it may be moved easily from place to place in the shop or laboratory. A feature of the caster mountings is the leveling screw in each foot of the stand, by means of which the instrument may be leveled on an uneven floor. The projector does not require a darkroom, but may be operated successfully in any room, provided the image is not exposed to a direct ray of light, as from a window.

For ordinary sized work the image is projected on a chart which is part of the instrument, the position of which may be varied as required to increase the magnification. For this purpose the chart is attached to a holder. An arm on the holder has bearings on the two uprights of the stand so that the chart may be located vertically in any position. Besides using a chart for comparison, the holder is designed to accommodate a photographic plate holder as well, so that permanent records of the results may be obtained. The image is projected vertically downward to the chart or plate holder and a curtain is draped around it to exclude light and intensify the sharpness of the outline projected. The fact that the screen is part of the instrument itself prevents the vibration which is often a cause of much trouble where an independently supported screen is used.

The work-carrier consists of a compound slide which may be adjusted in three directions by means of handwheels to bring the work into proper position in the optical rays. The adjustment of the work within the field is the means for focussing the image on the screen. The source of light regularly used is a special concentrated single-filament, 6-volt, 108-watt Mazda lamp, which may be lighted by connecting it to a lamp socket. This lamp furnishes a steady illumination and is inexpensive to operate. For extremely careful work the "Tungsarc" lamp is recommended or where greater intensity of light is desirable, such as when projecting gear contours at high magnifications. An arc lamp, however, may cause difficulty in maintaining a steady illumination, due to fluctuations.

Fixed Optical System

The optical system used in the Bausch & Lomb projector is of special design and is shown diagrammatically in Fig. 3. The system is fixed—that is, the illuminating, reflecting, and magnifying units remain in fixed relation to each other and the image is sharply focussed by changing the position of the work in the field instead of by moving any of the optical system units. The source of light is graphically indicated at *A*, from which the rays pass through a condenser consisting of a special lens *B* and a supplementary condenser *C*.

The lens and the supplementary condenser are mounted in a long cone (see Figs. 1 and 2) which keeps them in permanent optical alignment. The lens is contained in a focussing mount by means of which it can be adjusted to direct the beam of light to the focal point of condenser *C*, Fig. 3. This causes a concentrated beam of parallel light rays to issue from the iris diaphragm *D* which is located directly

in front of the condenser at the end of the cone. This diaphragm is for adjusting the diameter of the beam of light. The rays pass and intersect the outline to be inspected, the work being positioned within the field as at *E*, and the interrupted rays then pass through the objective lens *F* of a compound microscope.

Beyond the eye-piece *G* of the microscope there is a right-angle prism *H* which reflects the light down and casts the image on the chart or plate, as indicated at *I*. The prism is mounted in a holder *A*, Fig. 1, and may be swung out of the way if it is desired to project the light straight on a large screen instead of vertically downward. This is often necessary in the case of large work requiring high magnification. The compound microscope shown at *B*, is used in place of an ordinary projection lens, and in combination with the prism enables average work to be inspected with the screen or chart as a part of the machine. The advantage of this arrangement is clearly indicated in the illustrations. It also permits the machine to be no larger than would ordinarily be required for the optical system alone.

Selection of Lenses and Eye-pieces

As previously stated, focussing is accomplished by changing the position of the object, not by moving the lenses. The instrument is generally furnished with a 24-millimeter (focal length) objective lens contained in a long tapering mount of small diameter so that it may extend over the top of large diameter gages as shown in Fig. 1. A 48-millimeter objective lens is used where less magnification or a larger field at a greater projection distance is wanted. The eye-pieces regularly employed with these lenses are of 5 and 12.5 times magnification, respectively, and the combinations furnish a wide range of magnification. This equipment permits the projection of threads of 1/3 inch pitch or less and gears of 12 diametral pitch or finer. A chart giving the magnification when the chart holder is set at a specified distance from the prism and when certain combinations of these lenses and eye-pieces are used, is referred to when setting up the machine.

When a vertical screen is used separately from the instrument, as when projecting a large contour, special lenses are employed. These lenses replace the compound microscope which may be completely removed from the instrument and the prism swung aside to permit the projection of the image on the vertical screen. The supplementary condenser *C*, Fig. 3, is also removed together with the iris diaphragm *D*, and the illuminating beam of light is made parallel by the focussing movement of lens *B* which may be moved on a helix by a lever. In connection with the focussing of the lens *B*, the position of the lamp in its housing *C*, Fig. 1, must be adjusted until an image is properly formed on the screen. This adjustment is made after the compound microscope has been removed and before the other lens is installed.

Relation of the Optical System to the Thread Helix when Inspecting Screws

When the apparatus is used as a thread projector, the principle employed is different from that of other optical instruments in that the optical system is arranged so that it can be swung to the helix angle of the thread. The entire optical system at all times is lined up along a single central axis, being held in this relationship by the bar *D*, so that the system may be swung about the swivel bushing *E* which contains a vernier scale. The rear part of the system including the lamp, special lens *B* and supplementary condenser *C*, are supported on an arc-shaped rail along which this part of the system may be slid when adjusting the axis of the light beam at the helix angle of the screw.

This method does not give an image which is geometrically similar to the thread contour in the plane of the screw axis, but one which is geometrically similar to that lying in a plane inclined at the mean angle of helix. The two contours are slightly different, but the error from the true outline of the screw thread is so slight that it is rarely considered of importance. For example, for a 60-degree thread and a helix angle of 5 degrees, the angular correction would be 12 minutes; when the helix angle is 2½ degrees the angular correction would be 2 minutes, 40 seconds. It will be seen that the correction factor may be disregarded for even the most exacting commercial work when the helix angle is 2½ degrees or less; even when the helix angle is 5 degrees, the results will be sufficiently accurate for most commercial work.

This method of projecting the screw thread differs from that incorporated in instruments of other makes which are so constructed that the axis of that part of the optical system which serves for illumination is tangent to the thread helix, while the axis of that part which serves to form the image is perpendicular to the axis of the screw. The purpose of the latter arrangement is to project the section of the screw in the plane of its axis. As a consequence, the image is formed by oblique "pencils" of light passing through the margin or edge of the objective lens. The Bausch & Lomb Optical Co. considers that the result obtained in this way is likely to produce an image not always geometrically similar to the screw thread section, owing to the aberration. The centered optical system incorporated in the instrument here illustrated was adopted for the purpose of eliminating these difficulties. The angular error is a well-defined function of the flank angle and of the mean helix angle and can be calculated for all threads.



Fig. 2. Measuring the Lead of a Thread Gage

Thread Chart and Photographic Plate Attachments

The adjustable thread chart, Fig. 4, is used for the inspection of threads and is provided with a graduated arc and vernier scale by means of which it can be swung at an angle to bring it into line with the optical system as deter-

mined by the reading shown by the graduated scale on swivel bushing *E*, Figs. 1 and 2. A single chart serves for threads of different sizes and various magnifications, because adjustable templets are provided which may be accurately set to any size. These templets have adjustable straightedges which may be set to give the proper width of flat on root or top, corresponding to the pitch of the thread.

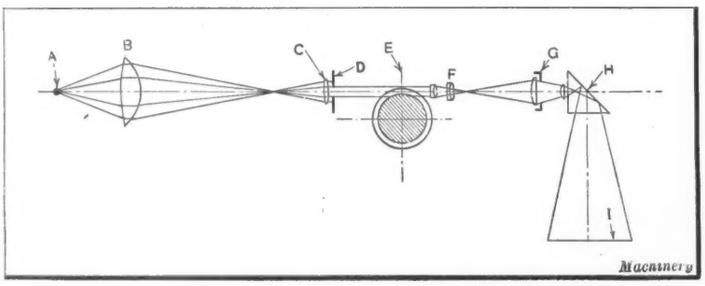


Fig. 3. Diagram of the Optical System

Attachments that Increase the Field of Application

A lead-measuring attachment, which checks the lead to 0.0001 inch, is used when inspecting screw threads. It consists of a dial gage and a micrometer head attached to the side of the cross-slide. This and all other attachments used with the projector are interchangeable on the cross-slide which is machined with a T-slot on the side for convenience in attaching.

A device which facilitates the inspection of screws and which will accommodate work up to 2 inches in diameter, is shown in Fig. 5. This is a universal screw-holder which is attached to the cross-slide in place of the two centers regularly used for centered work. This is very simple in construction and rapid in operation, and its use enables the pitch diameter, root clearance, thread shape, external diameter and accuracy of lead to be quickly inspected. The device supports the screw entirely from the effective diameter of the threads. As many threads as are intended to be subsequently engaged in a tapped hole, are engaged by the blades *A* and *B*. By combining unavoidable errors in lead and diameter, the image on the chart will instantly show whether or not the screw will assemble into the tapped hole.

Other attachments are a sulphur cast attachment by means of which casts may be taken of internal threads; a V-block attachment (see Fig. 1) for holding irregular-shaped pieces, especially lead-screws and similar long threaded work; and a gear attachment. The V-block attachment is simply two blocks each having a vee on the side as well as on top, and a clamping arrangement. The gear attachment, Fig. 6, is also of simple design; it consists of two brackets, each carrying a stud so that gears may be mounted and inspected while in mesh. An indexing pivot can be centered in the tooth spaces, so that as the gears are turned errors in tooth spacing can be detected.

The instrument should be placed in such a way that light will not fall directly on the work chart. A moderately lighted room is satisfactory, so that there need be no inconvenience from working in the dark. To adjust the optical system, the light is turned on, the diaphragm *D*, Fig. 3, opened wide, and the special lens *B* focussed by a lever projecting through the cone in which it is contained. Proper focussing will produce a circle of light about ¾ inch in diameter on a piece of paper held in the plane of the object. Two screws at the bottom of the lamp housing are then used to centralize this image with respect to the objective lens of the microscope. When this has been done, the set-up remains in this position until it is again required to adjust the system, which should be necessary only when other lenses and eye-pieces are used to obtain greater magnification.

A master gage is then placed between centers (or located in the V-block attachment) and the optical system swung to the helix angle of the thread on the arc-shaped rail *F* in Fig. 1. The setting is read on the graduated swivel bushing *E* and this reading should correspond with that obtained when locating the chart *G* to align it with the axial line of the optical system. To raise or lower the gage, a handwheel underneath the machine is adjusted, while to move the gage horizontally the cross-slide is moved in the manner shown in Fig. 2, by a knob on the right-hand side of the machine.

These adjustments should bring the upper part of the thread into the beam of light where it can be focussed by bringing it back or forth by turning a handwheel at the front of the instrument. A fuzzy outline of the image accompanied by bright line reflections near and parallel to the contour of the thread outline is an indication of poor adjustment, incorrect angular setting of the optical system, or an error in centering the beam of light.

Setting the Universal Chart

Attention is next called to the universal chart, Fig. 4. This should now be rotated so that master lines representing the flanks of the thread coincide with the outline of the image. This determines whether the thread is "leaning" to one side or the other. "Leaning" is one of the most frequent causes of ill-fitting threads and it can be detected at a glance when the image is compared with the flanks of a master thread form. The reading on the graduated arc of the chart should then be compared with that of the

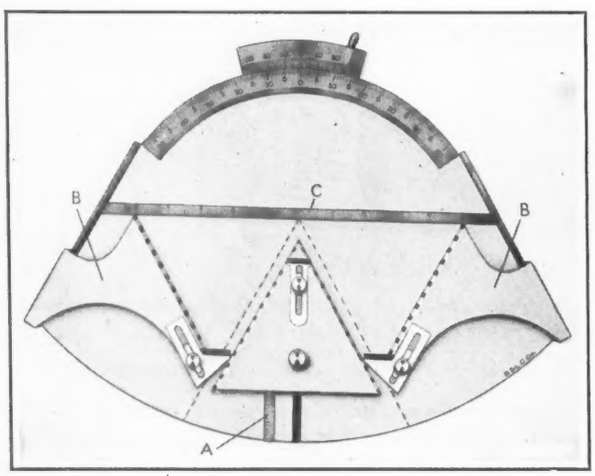


Fig. 4. Adjustable Thread Chart which is Part of the Optical Instrument

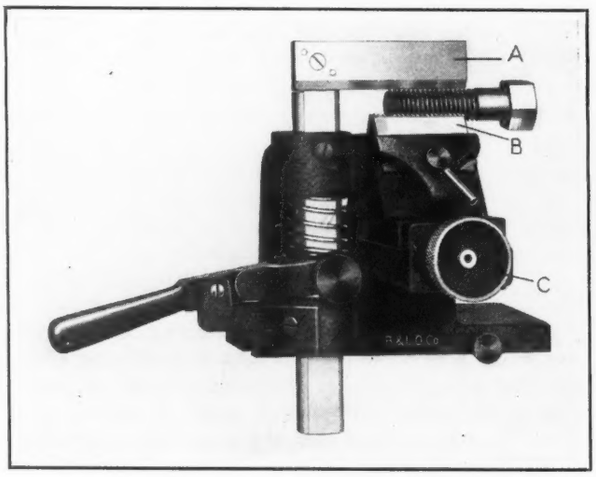


Fig. 5. Universal Screw-holder for Use in inspecting Machine Screws

vernier on swivel bushing *E*, Figs. 1 and 2, and if they fail to agree it shows that the thread leans—that it is unsymmetrical.

Next determine whether the axis of the gage is parallel to the line of travel of the slide; if it is not, an accurate measurement of lead is impossible. To determine this, adjust the position of the gage so that the image of one end thread will fall on the center templet of the chart. The slide is then adjusted until the edge of the image appears equally distant from both sides of the master lines with a faint thread of light between them. The cross-slide should then be moved in the opposite direction until the thread at the opposite end of the gage casts an image on the chart, bearing the same relation to the master lines as that of the first thread image. If the image from the last thread appears above or below the master outline, it indicates a tapered gage or one that is not true on centers.

It is always advisable as a precautionary measure to rotate the gage by hand after it has been sharply focussed. This may show faults and irregularities in the thread which might otherwise not be detected. Often a gage may be so distorted in hardening that when it is inspected and revolved before the light there will be an irregular movement of the thread image as it travels across the chart. A true helix would show a uniform advance. If the image rises and falls as the gage is being turned, it shows that it is out of round. The most minute irregularities of the thread are thus made obvious.

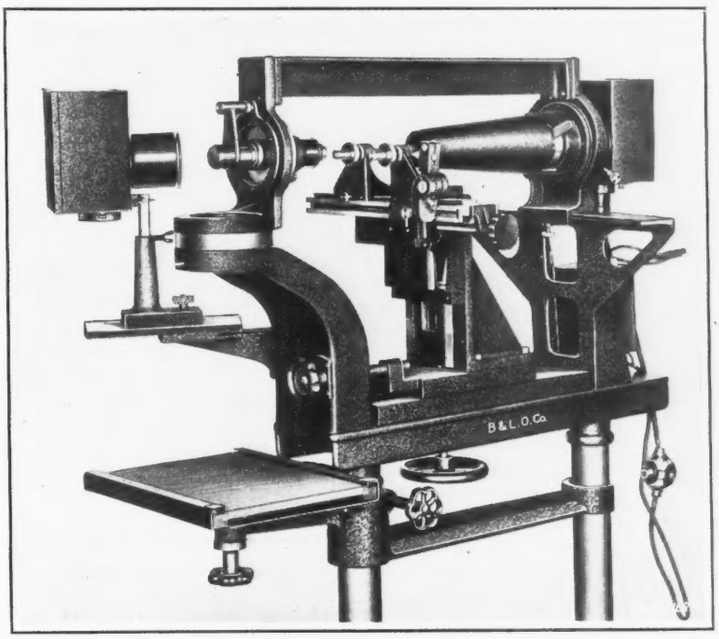


Fig. 6. Instrument equipped with Gear Attachment, Special Optical Arrangement and Photographic Plate Holder

In measuring the lead of a thread, the image of one side of the thread is first made to coincide with one of the master lines on the chart. The dial gage shown in Figs. 1 and 2 is then slid along in the T-slot on the side of the cross-slide until it contacts with the micrometer spindle which is set at zero. The micrometer head does not move; it is attached to the upright support of the cross-slide. The position of the dial gage needle when the spindle is in contact with the micrometer spindle should then be noted and should preferably be at zero to facilitate reading the micrometer.

The cross-slide is then moved back until the image of the next thread (or any other selected thread) is brought up to the same position that the first thread occupied. The micrometer drum is then turned until the spindle advances into contact with the gage spindle and causes the gage to register as before. The micrometer reading is obtained in the regular way. The dial gage merely serves as a reliable zero point and eliminates the sense of touch which often results in errors in micrometer readings.

Use of Optical Instrument to Obtain Actual Measurements

It has been previously stated that actual measurements of screw threads and other parts may be made with the aid of the projector apparatus. To do this the proper objective lens and eye-piece should be selected from the chart prepared by the manufacturers of the instrument, which will give approximately the desired magnification. If a gage 5 inches in diameter having 40 threads per inch is to be measured and the magnification is to be 100 times, a 24-millimeter focal-length lens and a 5-times eye-piece would be used, and the master thread chart would be located about 29½ inches down from the right-angle prism.

To find the exact position of the chart, the centers (similar to the lathe centers) are separated 1/10 inch and they are focussed on a piece of paper on which two reference lines are drawn 10 inches apart. This piece of paper is placed on the chart which is vertically adjusted until the image of the center-points exactly coincides with the reference lines and is sharply focussed. When this condition is obtained the magnification is 100 times.

In obtaining the actual measurements after these adjustments have been made, the thread chart, Fig. 4, is set to one hundred times the actual size of the thread to be compared. To set the chart, the center templet is set to zero on the vertical scale *A*, and the side templets *B* are located so that their edges intersect the scale *C* and indicate one hundred times the actual pitch measurement, which for a forty-threads-per-inch screw, would be 2.50 inches either side of the zero graduation. The auxiliary templets which define the top and the root of the thread are then set by means of a scale on their edges. In the case of a forty-threads-per-inch screw, the width of the flats is ⅛ the pitch multiplied by 100, or 0.314 inch. The chart is then set to the helix angle which in this case is five minutes. To obtain the actual measurement of screw thread elements after the apparatus has been set up to give a definite magnification, divide the width of any space between the image and the master outline by the magnification, which in this case is one hundred, and subtract the quotients from the corresponding standard dimensions.

Inspecting Screws in Quantity

The universal screw-holder, Fig. 5, is used for inspecting automatic screw machine products. The holder is attached to the cross-slide and two pitch blades *B* selected having the required number of threads per inch. One blade is locked firmly in place in an angular position while the other is clamped lightly so that when setting up it may be pushed back and forth without releasing the clamp.

A master thread gage, of the same nominal size as the screw to be inspected, is then laid on the two blades so that it is supported by them. Handwheel *C* is then turned so that the two blades will point radially to the center line of the thread gage. The upper blade *A* clamps the screw in position and is moved up and down by means of a lever and held in place by spring tension. The pressure exerted by this spring is sufficient to cause the unclamped blade to center in the threads of the gage, in which position the blade is clamped. After the holder has been set up, the inspection of screws can be done rapidly. The blades act as a ring gage, only that part of the screw actually used being entered. Adjustments are then made until the top

threads of the gage are properly focussed on the comparison chart. Assuming that the chart and optical system has been set up as previously described, the image from this master gage will represent the maximum permissible size of the screw to be inspected. By setting the chart templets to the minimum allowable diameter of the screw, a tolerance zone is established. This working tolerance zone can be quickly established with the adjustable chart arrangement to suit any thread tolerance.

Inspecting Gears with the Projector

With the optical projector it is possible to check the contour of gear teeth, form cutters, etc., and determine at a glance the form, rolling action, center distance, etc., that otherwise would be difficult to ascertain. For handling gears, special brackets (see Fig. 6) are attached to the cross-slide, these brackets having ½-inch diameter studs, over which the gears are placed, using bushings if necessary. The brackets may be positioned so that the gears will mesh; then by rotating them at an even rate the rolling and sliding actions of the teeth may be observed as well as any imperfections in tooth shape. Thickness and height of teeth can be measured to within close limits by employing an adaptation of the method previously described for obtaining actual measurements of screw threads.

The light is passed along the tooth surface at the point of contact (in the case of spur gears) but in this application of the instrument, it is usually advisable to project the image on an auxiliary screen located at right angles to the axis of the optical system and approximately ten feet away. It is important when inspecting the gears with the projector, to see that the face of the gear toward the objective lens is free from burrs at the edge of the teeth. Slight burrs may often erroneously indicate a poor tooth form. It is good practice to locate the face of the gear from which the forming cutter entered in milling the teeth, toward the objective lens. In obtaining the proper center distance, measurements are taken over the studs on which the gears are mounted, using calipers.

The projector is not limited to inspecting spur gears. In the case of spirals, it is necessary to illuminate the face of the gear adjacent to the objective lens by oblique or normal illumination. This is called "opaque" projection. The best results can be obtained from this method of inspection only by having the surfaces of the gear against which the light is directed highly polished so that they will furnish a good reflecting surface. Lapping the surface on a cast-iron plate using fine emery and oil will usually give the desired finish.

The optical arrangement for helical gear inspection, in which the light is reflected to produce the image, is different from that ordinarily used. A special attachment consisting of a lamp housing, is mounted on a bracket bolted to the rear side of the bracket supporting the swivel bushing. The lamp can then be set so that the rays of light from the lamp are directed against the face of the gears or other parts. A 6-volt, 108-watt Mazda lamp is used, fitted with a condenser. The arrangement can be used only with low-power objective lenses.

* * *

FINDING SPIRAL ANGLE OF MILLING CUTTER

By C. A. MACREADY

There are several methods of finding the "spiral" or helix angle of a milling cutter, but the writer believes that the one described in the following will be found the quickest and most convenient. The method described also has the advantage of leaving the work in position to be recut in case this is necessary. The procedure in determining the spiral will be given for the purpose of making the method clear. It should be mentioned that the method is the same regardless of whether the cutter is a new one or an old one that has been annealed and turned down until only the bottoms of the tooth spaces remain.

The cutter is first placed on the arbor and index-centers of a milling machine. An indicator is next clamped between the collars on the milling machine arbor in such a position that the point is in contact with one side of the milling cutter tooth. A piece of sheet metal may be used in place of an indicator if no indicator is available or in cases where a groove or tooth is so shallow that it will not give a suitable bearing surface for the contact point of the indicator. The dial on the table feed-screw must also be in position to record the longitudinal movement of the table, and an index-plate having an indexing circle of, say, twenty holes must be used to record the arc of travel through which the milling cutter tooth is revolved.

Referring to the accompanying diagram, let E represent the milling cutter, F the indicator, B the longitudinal distance through which the milling machine table or milling cutter is moved, and D the arc through which the cutter rotates during the longitudinal movement B.

Let A = number of holes indexed;

B = distance traveled by milling machine table; and

C = 40 × index circle used, or 40 × 20 = 800.

The circle can thus be divided into 800 parts by using the

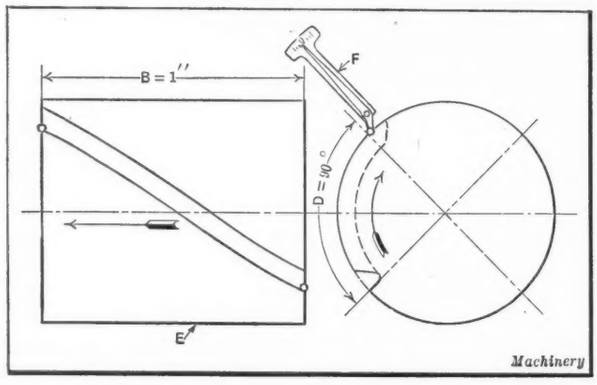


Diagram illustrating Method of finding Spiral Angle of Cutter

20-hole circle. The spiral in inches can now be determined by the formula

$$\frac{C \times B}{A} = \text{length in inches for one complete turn of spiral}$$

Assume that the micrometer dial shows that the table has been given a longitudinal movement B equal to 1 inch, and that the index-plate has been given exactly ten complete turns, the indicator F still registering zero. Then A = 20 × 10 = 200; B = 1 inch; and C = 40 × 20 = 800. Substituting these values, we have:

$$\frac{CB}{A} = \frac{800 \times 1}{200} = 4$$

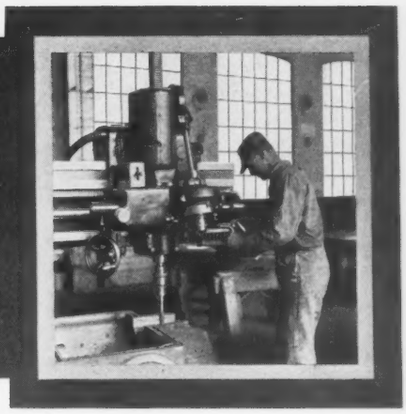
Thus the spiral is found to equal one turn in 4 inches. This is perhaps an ideal illustration of the method, as it will be noted that ten turns of the index-plate or an indexing movement equivalent to 200 holes in the 20-hole circle equals ¼ turn of the work or an arc of rotation D equal to 90 degrees. Now taking a case such as is frequently met with in practice, let it be assumed that A equals 206 (10 turns and 6 holes) instead of 200 as in the previous example. We then have:

$$\frac{CB}{A} = \frac{800 \times 1}{206} = 3.883$$

In this case the lead of the spiral is taken as one turn in 3.89 inches, as this is the nearest spiral given in the table of spirals accompanying the milling machine. The variation from the value 3.89 inches is due in this case to the fact that the index circle used could not register an even number of holes for the arc through which the cutter was rotated.



Letters on Practical Subjects



FEEDING WORK INTO ROTATING CHUCK

The feeder head shown in Fig. 2 was designed by the writer for the purpose of feeding drop-forgings into the rapidly rotating chuck of an automatic turret lathe. The forging for which the feeder head was originally designed is shown in Fig. 1, but the device can be adapted for feeding short-length work of various kinds into a lathe chuck without stopping the machine. For instance, parts made from bar stock of round, square, or hexagon section could be handled readily by a device of this type.

Referring to Fig. 1 it will be noticed that a square boss *A* projects from one side of the drop-forging. In machining this forging, it is necessary to insert the boss *A* in a square hole in the chuck. The machining operations required were as follows: Face one side; turn and thread the edge; and back-face a portion of the side from which the square boss projects. After several methods of chucking the work had been proposed and rejected as impracticable, the writer suggested that the work be put in the chuck without stopping the machine. It was first thought that this was impracticable, as it was believed that the square boss on the forging would have its corners knocked off in the effort to make it enter the revolving chuck jaws. If the work had been held stationary, this undoubtedly would have been the case, but the feeding head permits the work to revolve at the same speed as that of the chuck with just sufficient frictional drag at the entering position to cause the work to slip until the square corners of the boss match the hole in the spring jaws of the automatic chuck.

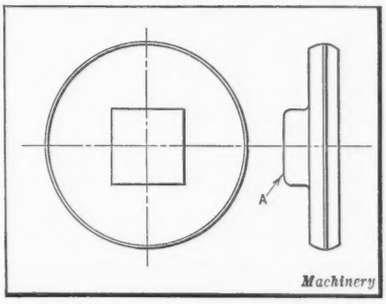


Fig. 1. Type of Forging handled by Device shown in Fig. 2

If the forgings are pressed against the chuck too hard at first, there will be no slipping and the forging will not enter the chuck unless it happens to be in the correct position at the instant of contact. To obtain a light pressure at first when the work is being made to enter the chuck a light spring *D* of long stroke (Fig. 2) is used. A stronger spring *E* comes into operation near the end of the turret head stroke which holds the forging firmly against the chuck during the closing action of the jaws. A small spring *F* at the end of the spindle provides pressure between the spindle and the sleeve *B* at the cup end that holds the forging. This causes a frictional drag that is sufficient to make the feeder head revolve at a little slower speed than the chuck until the work has been properly entered.

As the revolving element is acted upon by two springs, it is provided with a sleeve *B* which holds the springs and which is free to slide back and forth in bushing *C*. Bushing *C* is held in turret bracket *H*, and a key *J* in the bushing prevents sleeve *B* from revolving. The small finger springs *G* hold the forging in the feeder head cup of spindle *A*. These finger springs open and release the forging on the backward stroke of the turret. If the friction drag spring *F* is screwed up too tight, spindle *A* will not turn and the forging will then slip inside the finger springs *G*. While this will permit the work to be loaded into the chuck it subjects the finger springs to undue

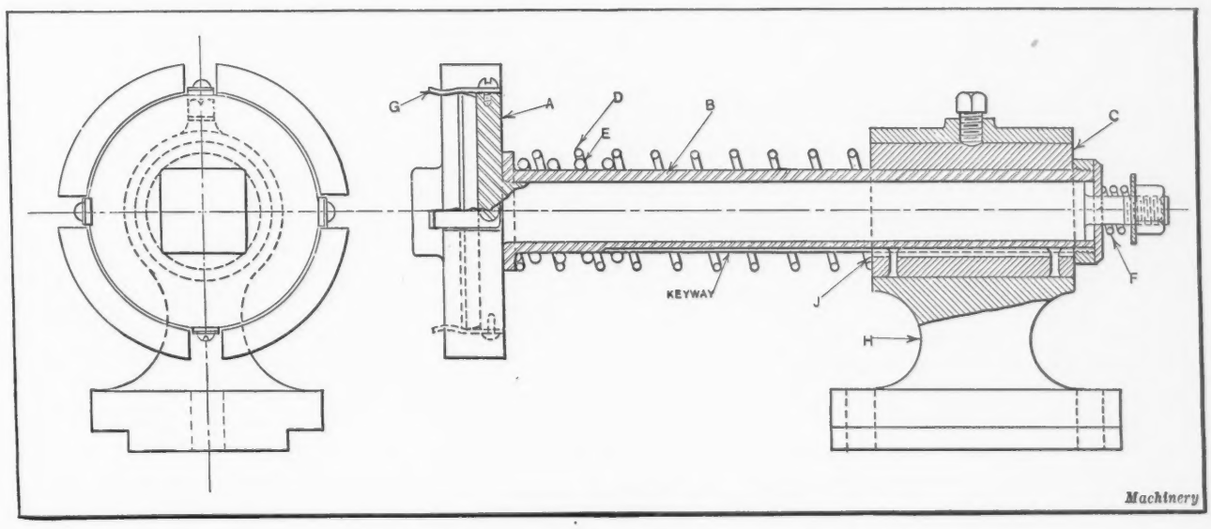


Fig. 2. Device designed for feeding Drop-forgings into a Rotating Chuck

wear due to the rough scale on the forgings. Several machines were equipped with feeder heads that were not provided with revolving spindles but depended on the slipping of the finger springs to obtain the desired results. This arrangement, however, was not so satisfactory as the design illustrated.

Lyells, Va. W. R. WARD

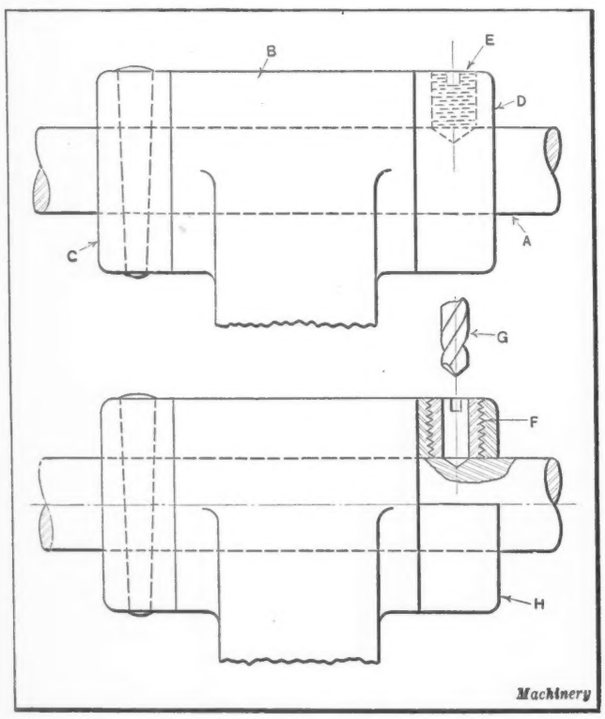
SPOTTING A SHAFT FOR A COLLAR SET-SCREW

In the upper view of the accompanying illustration is shown a shaft *A* which runs in a bearing *B*. The shaft is held in position by two thrust collars *C* and *D*. The thrust collar *C* is pinned to the shaft, while collar *D* is held in place by a conical pointed set-screw *E*. Shaft *A* is spotted to receive the point of the set-screw after the shaft is assembled in the bearing. The writer has frequently encountered this construction, and in most cases has found it difficult to locate collar *D* properly on the shaft by the methods generally employed.

It is quite common practice to spot the shaft with the tap drill used to drill the set-screw hole in the collar, the procedure being first to drill the collar with the tap drill and then use the collar as a drill jig for spotting the shaft. After being tapped, the hole will not always line up properly with the spot on the shaft. Thus considerable end play between the collar and the bearing often results, which must be taken up in some manner. In order to overcome this difficulty, a number of spotting bushings like the one shown at *F* were made up from headless screws. These bushings were made of different sized screws from 3/16 inch up.

The holes in the bushings *F* were made as large as they could be without weakening the bushings so much that they would be likely to break during the hardening operation. These jigs or bushings were all provided with slots to receive the blade of a screwdriver. By placing the spotting bushing *F* in the tapped hole of a collar *H*, which is to be used on the shaft, and then bringing the drill *G* down through the hole in the center of *F*, the shaft can be spotted very quickly and as accurately as it could be done with a more expensive tool or jig.

Bridgeport, Conn. A. H. PONELEIT and A. BIRCHALL

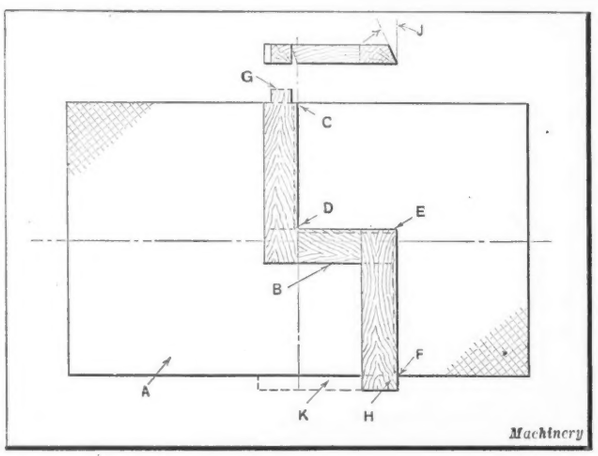


Method of spotting a Shaft for locating a Collar Set-screw

STOPPING-OFF PIECE FOR FLOOR-PLATE PATTERNS

Patterns for diamond-checked floor-plate castings of standard size are kept in stock by some companies. When plates of special shape or design are required, it is common practice to use a pattern of standard size in making the mold, and employ a stopping-off piece to cut the mold down to the desired size and shape. If a floor-plate is required of a size larger than any provided by standard patterns, blocks are added to one of the regular patterns to obtain the desired size. In no case should a regular pattern be cut if it can be avoided. When patterns provided with stopping-off pieces are to be sent away to a foundry where the molding operations cannot be observed, it is necessary to provide some means of insuring the proper location of the stopping-off pieces. Chalk marks on the pattern showing the location of the stopping-off piece are not to be relied upon, as they wear off quickly.

The best plan is to make the stopping-off piece with ends that project beyond the edges of the floor-plate pattern, as shown in the accompanying illustration, and attach temporary blocks or prints to the edges of the pattern. The pieces attached to the pattern should correspond to the projecting ends of the stopping-off piece, so that they will leave pockets in the mold into which the ends of the stopping-off piece will fit. In order to prevent the stopping-off piece from being reversed in the mold, one of its ends should be made smaller than the other. The corresponding print or



Stopping-off Piece for Floor-plate Pattern

block attached to the pattern should, of course, also be made smaller. By this arrangement it would be impossible for the molder to reverse the position of the stopping-off piece, which he might easily do if the ends were made flush with the sides of the pattern.

In the illustration, *A* represents a floor-plate pattern of standard size, and *B* a stopping-off piece designed to stop off the casting along line *CDEF* so that the floor-plate will have the shape indicated at the left of the stopping-off line. After making a mold of the complete floor-plate in the usual manner, the stopping-off board is put in place on the mold, with the projecting ends *G* and *H* in the pockets formed by the corresponding pieces attached to the plate pattern. The space to the right of the stopping-off piece is then filled in with molding sand to the top of the board, after which the latter is removed, thus completing the mold.

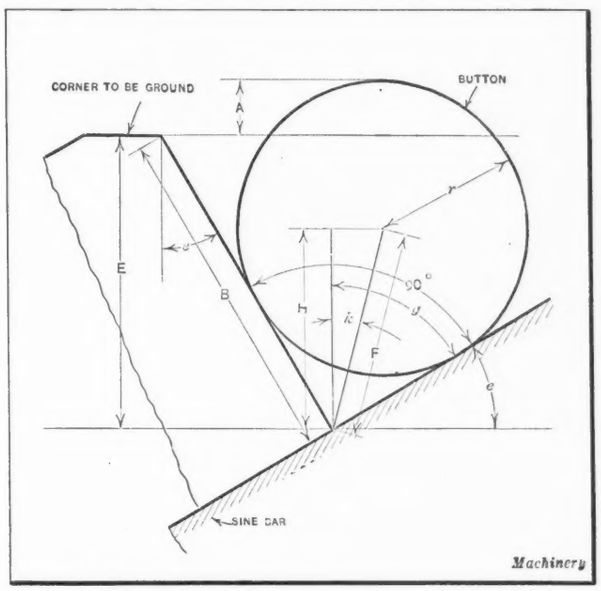
In order to obtain a close fit between the edges of the cast-iron floor-plates, a slight bevel is given to the stopping-off board along the stopping-off line. The angle at *J*, although somewhat greater than that used in actual practice, serves to indicate the method of beveling the stopping-off piece. In order to prevent the stopping-off piece from pressing down too hard on the check impressions in the mold, a large block, such as indicated by the dotted lines at *K*, is some-

times attached to the pattern in place of the smaller blocks. Corresponding blocks attached to the stopping-off piece then serve to support the weight of the stopping-off board, so that the check impressions will not be disturbed.

Kenosha, Wis. M. E. DUGGAN

CHECKING A TOOL-ROOM JOB

This article describes a method of determining when an angular corner of a block is so formed that one side of the block will have a given width B, as indicated in the illustration. The procedure is to mount the work on a sine bar as shown, with the sine bar set at the angle to which the corner of the block has been ground. The button is set on the sine-bar and in contact with the work.



Method of checking a Tool-room Job

The known dimensions are as follows:

e = angle to which corner of block is ground;
B = width of side of block; and
r = radius of button.

With these dimensions it is required to find the difference in height between the corner of the block and the top of the button, as indicated by dimension A.

By trigonometry we have

$$E = B \cos e \quad \text{and} \quad F = r \text{ cosec } 45 \text{ degrees}$$

Then

$$g = 90 \text{ degrees} - e \quad \text{and} \quad k = g - 45 \text{ degrees}$$

By trigonometry

$$H = F \cos k$$

and

$$H = r \text{ cosec } 45 \text{ degrees} \cos k = 1.4142\ r \cos k$$

Then

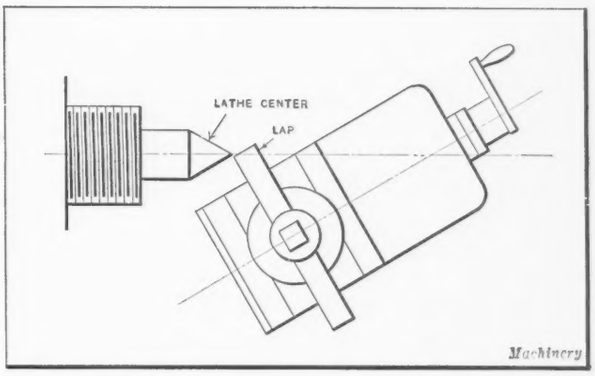
$$A = H + r - E \text{ or } E - (H + r)$$

The value taken depends upon whether the top of the disk is above or below the top of the machined corner. In the case illustrated the top of the disk is above the top of the machined corner so that $A = H + r - E$.

Flint, Mich. W. G. HOLMES

TRUING UP A LATHE CENTER

In order to face both ends of a piece of work held between centers on a lathe, it is usually necessary to reverse the piece, or turn it end for end. It is often found, however, that the work will not run true after its position has been reversed. This is usually because the headstock center does not run true. The amount that the center runs out may be so small that it cannot be detected unless a very sensitive indicator is used, and yet it may be sufficient to cause considerable inaccuracy in the work. It is very difficult to keep the centers absolutely true, and it has been the writer's experience that even after a center has been ground with a toolpost grinder, it will still run out from 0.00025 to 0.0005 inch.



Method of truing up Lathe Center with Cast-iron Lap

It is hard to tell just what causes this inaccuracy, as in the cases noted there was apparently no play or shake in either the lathe spindle or the grinder spindle. As a test, a center thus ground was indicated, and the spindle marked at the point corresponding with the high spot on the center; then another center was ground, using exactly the same set-up. In the case of the second center the position of the high spot was between 90 and 100 degrees from the point marked on the spindle in the first instance. This test would seem to show that the inaccuracy was not due to the spindle hole running eccentric with its outside diameter. It would be interesting to receive some comments as to the reason for the inaccuracy recorded by these tests.

The writer has found, however, that the inaccuracy referred to may be corrected in the following manner: After removing the grinder a cast-iron lap is clamped in its place, as shown in the illustration. No cutting compound is used, the structure of the cast iron being such that the desired result is obtained without the application of any abrasive. A few drops of oil applied to the lap and a little pressure of the lap on the center is all that is required. The compound slide, of course, is left in the same position that it occupies when grinding.

Cleveland, Ohio WILLIAM WILSON

OBSERVATION TIME-STUDY TICKET

The 8½- by 11-inch observation sheet ordinarily employed in recording time-study data for use in setting piece-rates is well adapted for cases involving a comparatively large number of operation details. However, when there are but few details that require studying, a small size observation ticket such as shown in Figs. 1 and 2 will be found more convenient and economical.

Ordinarily, if the time-study man makes a trip to the shop without his large pad of observation sheets (as often happens) and is called upon to make an observation, he must return to his office for the pad. But if he is provided with a small size pad like the one described in this article, he will invariably carry it in his pocket ready for use. In ruling up the small sheets, the writer had this point in mind, and accordingly made the size about 6 by 4 inches so that a pad made up of the sheets could be easily carried in the pocket.

To those not familiar with the piece-work system, the following description of the procedure in making a time-study and recording the necessary data may be of interest. Let it be assumed that the rate-setter is called into the shop to make a time-study of a certain piece of work. It should be mentioned here that the observation ticket is made up in pads with the side marked "Detail Operation" (as shown in Fig. 1) to the front. The rate-setter first lists the detail

No.	Detail Operation	1	2	3	4	5	6	7	8	9	10	Avg.	Min.
1	Chuck work	.1	1.2	2.3	3.4	4.95	5.6	6.7	7.75	8.8	9.9	.11	.1
		.1	.1	.1	.15	.10	.15	.1	.1	.1	.1		
2	Drill & rough turn	.4	1.45	2.6	3.6	4.75	5.9	7	8.08	9.1	10.2	.295	.2
		.3	.25	.3	.2	.3	.3	.3	.3	.3	.3		
3	Ream & finish turn	.7	1.75	2.85	3.9	5.05	6.2	7.25	8.38	9.4	10.5	.29	.25
		.3	.3	.25	.3	.3	.3	.25	.3	.3	.3		
4	Cut recess & face	1.0	2.0	3.15	4.28	5.35	6.5	7.55	8.6	9.7	10.8	.295	.25
		.3	.25	.3	.35	.3	.3	.3	.25	.3	.3		
5	Remove work from chuck	.1	2.2	3.25	4.25	5.45	6.6	7.65	8.7	9.8	10.9	.11	.1
		.1	.2	.1	.1	.1	.1	.1	.1	.1	.1		
6													
7	A- Average time per piece = 1.09 minutes												
8	B- Piece work allowance = .60 per hour												
9	A X B ÷ 60 min. = $1.09 per 100 Rate												
10													
11													

STANDARD 1.09 minutes per piece

Fig. 1. Time-recording Side of Observation Ticket

OBSERVATION TICKET PART NO. 290

PART NAME Wringer roll drive gear USED ON #25 Elec. Wash. Mach.

MATERIAL Cast Iron 85 pounds per 100 pieces

OPER. NO. 1 DEPT. #18 DESCRIPTION Drill, rough turn, ream and finish turn outside diameter, cut recess and face hub to length.

RATE PER 100 $1.09 OUTPUT PER HOUR 54 MACHINE NAME 1½" Warner & Swasey

MACH. NO. 201 ACTUAL RUNNING TIME 1.09 DATE 1-7-20

REMARKS: Above rate supersedes rate of $2.50 set 10-1-19 due to change in method and tools

J. J. B. OBSERVER

Fig. 2. Reverse Side of Ticket shown in Fig. 1

operations, as shown in the illustration in the left-hand column, and then proceeds to make a time-study on ten pieces of work.

This is done by taking continuous readings with the stop-watch. For instance, on the first piece the stop-watch registered 0.1 minute for the chucking operation, and 0.4 at the end of the second operation, which is that of drilling and rough-turning. After recording the stop-watch readings for ten pieces of work, the time for each detail operation is obtained by subtracting the stop-watch reading for the preceding operation from that of the operation under consideration. The actual time for the detail operation is then placed in the lower half of the space opposite the name of the operation and in the column used for that particular piece.

The average time for each detail operation is then calculated and placed in the column provided for it. The minimum time is also filled in as shown. The piece-rate is set on the work by the formula on the lower half of the ticket. After this has been done, the opposite side of the ticket is filled in as shown in Fig. 2, and the record cards made out and sent to the shop. The observation tickets are then filed away for future reference.

Aurora, Ill. JOHN J. BORKENHAGEN

SPECIAL SCREW MACHINE CHUCK

The screw machine chuck shown in the accompanying illustration was designed to be operated by means of the draw-rod mechanism of the screw machine. The clamping is accomplished without any longitudinal movement of the collet, and the work is located against a stop-member which is independent of the collet. This construction prevents the threads of the work from binding on those of the collet when the latter is released.

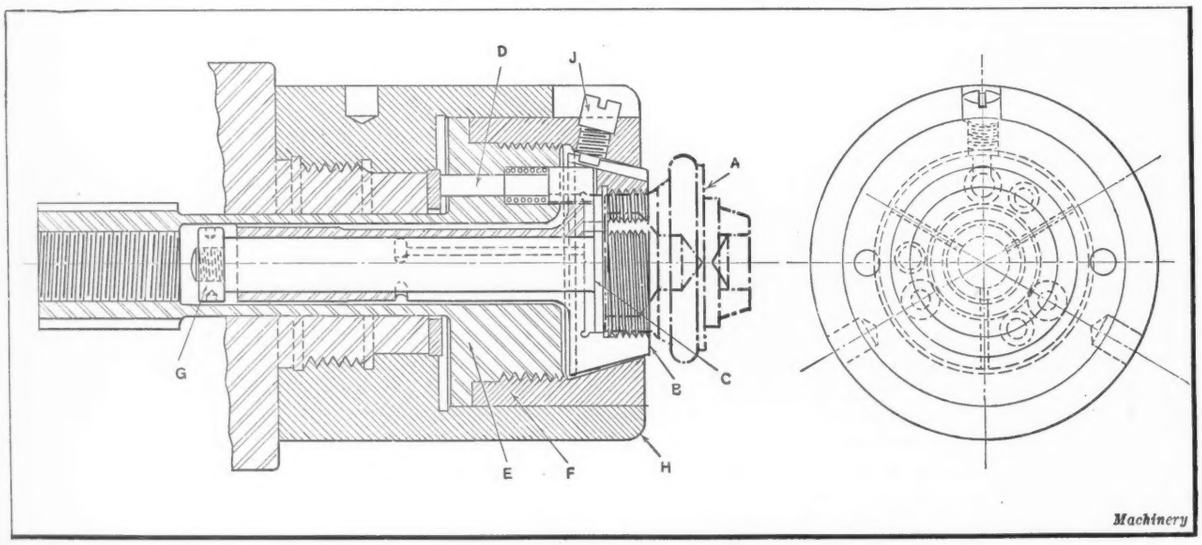
The work *A*, shown by the heavy dot-and-dash lines, is threaded into the collet *B*, and bears against the stop *C*, the thrust being transmitted against the spindle of the machine through the medium of the three spring-actuated plungers *D*. The plungers *D* are located in the collet-closing sleeve parts *E* and *F* which are threaded together. The collar *G* retains the stop *C*. The collet *B*, the closing sleeve *F*, and the chuck cap *H* are keyed together by the screw *J*.

Waynesboro, Pa. D. A. NEVIN

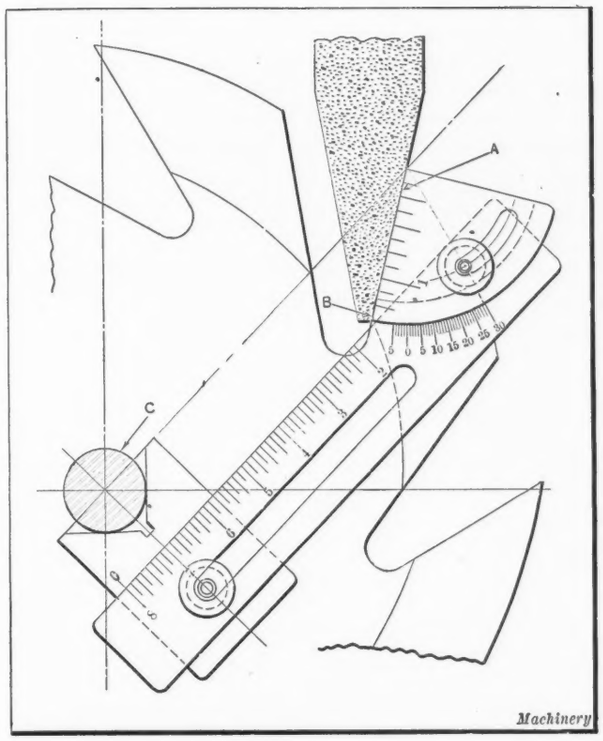
SETTING GRINDING WHEELS FOR SHARPENING HOBS

The wear to which grinding wheels are subject in operation is generally distributed unevenly over the working surface of the wheel. This is very noticeable in wheels used for form and angle grinding. In grinding gashes or flutes of hobs, the wheel is usually worn away fastest at the largest diameter as the wheel is weakest at this edge and has much more metal to remove. In form cutter and hob grinding, it is the general practice to make such allowances in truing the grinding wheel and setting the machine as will compensate for this uneven wear.

In sharpening hobs by grinding the tooth faces with the wheel set as indicated in the illustration, the wear on the wheel is less at point *A* than at the periphery *B*. Therefore if the grinding face is trued and set to grind work on a radial line, the finished surface will have a negative rake.



Special Screw Machine Chuck, operated by the Draw-rod Mechanism



Testing Angle of Wheel set to grind Hooked-tooth Cutter

This results from the more rapid wear near the periphery of the wheel, which actually changes the angle of the grinding face.

In order to produce a tooth having a radial face, it is necessary to set the wheel to grind "hooked" or "under-cut" a certain amount to allow for abrasion. To produce a hooked tooth having an under-cut of 8 degrees, for instance, it is necessary to set the wheel to a somewhat sharper angle, say, 9 or 10½ degrees. If this allowance is correct, the face of the tooth will have approximately the desired angle. No definite data regarding the amount of allowance, however, can be given, as this depends on too many variables. By measuring the tooth face angle after grinding, and then comparing this measurement with the angle of the grinding wheel face at the beginning of the operation, an operator soon learns what allowance to make for wheel abrasion. The allowance naturally depends upon the hob being ground, the kind of wheel used, and the kind of grinding machine employed. In order to reduce the allowance to a minimum, it is necessary to use a wheel of the correct grade and grain, and also to run the wheel at the correct speed, and employ a machine having well lubricated bearings of ample size.

A soft wheel will be worn away very rapidly when mounted on a light weight machine which allows considerable vibration, while a hard fine wheel will be abraded less rapidly. The hard wheel, however, is likely to burn the work, and has a comparatively low production rate. Again, if the wheel is too soft and is run at too low a speed, with a feed that is too small, or if the depth of cut is too heavy, the hob may actually turn the wheel down faster than the wheel can grind the hob. The difficulty in evolving a formula for determining the amount of allowance for wheel abrasion is therefore evident.

In form and angle grinding, it is necessary to have some means of gaging or testing the angle of the grinding surface of the wheel before and after the grinding operation. A gage that has proved exceptionally useful for this purpose is shown in the accompanying illustration. This gage makes it unnecessary to have separate radial setting gages and templets for hobs of different diameters and tooth forms. Another advantage is that the gage can be adjusted to include the allowance required to compensate for wheel abrasion.

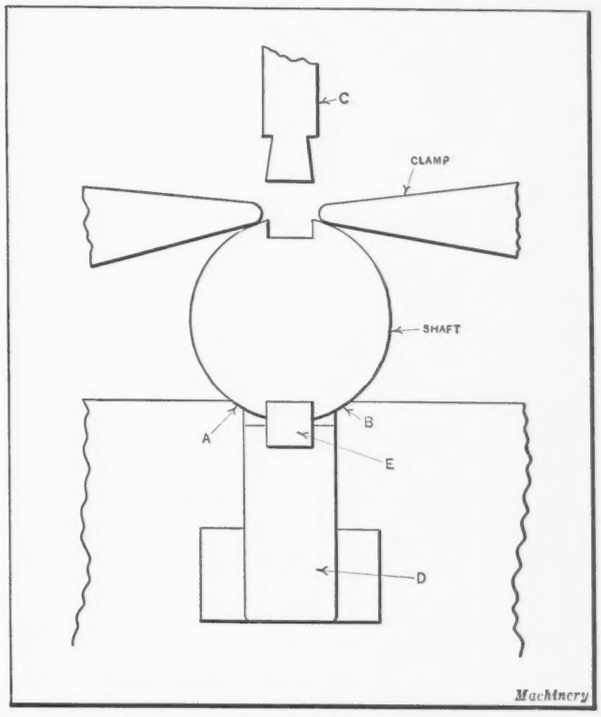
The capacity of the gage is for hobs and form cutters from 2 to 8 inches in diameter, and from 5 degrees negative rake to 30 degrees positive rake. This gage may be used on a hob or formed cutter grinder with the hob in position, as the measurements are taken from the tailstock center shown in cross-section at *C*. In the illustration the gage is shown set to test the angle of a grinding wheel for an 8-inch hob having an extreme hook or rake of 30 degrees, and a cutting face 1⅜ inches deep. This angle is not recommended; it merely illustrates the maximum angle to which the gage may be set. In applying the gage, the table of the machine is adjusted so that the tailstock center which supports the hob is directly under the center of the grinding wheel. The V-end of the gage is placed against the center *C* and the protractor edge swung upward into contact with the wheel as illustrated. Thus the gage may be employed for setting wheels to grind straight, left- or right-hand spiral flutes.

Bridgeport, Conn. HARRY E. HARRIS

CUTTING KEYWAYS IN LONG SHAFTS

The writer was recently confronted with the problem of cutting two ⅜-inch keyways diametrically opposite each other and extending the full length of a shaft 21 feet long. The shaft was 1¾ inches in diameter and the two ⅜-inch keyways were required to be spaced exactly 180 degrees apart. The accurate spacing of the keyways was necessary, as the shaft was required to be a good sliding fit in the broached holes of twenty-five steel gears. These gears, when assembled on the finished shaft, were required to slide the full length of the shaft.

The accompanying illustration shows diagrammatically the method devised by the writer for locating and holding the shaft on the planer bed. The table of the largest planer available was 20 feet long, but by allowing the shaft to overhang a little at each end it was found possible to take a cut of the required length. The first step was to plane a small bevel on the edges *A* and *B* of one of the planer T-slots so as to get a true surface on which to lay the shaft. The shaft was then clamped in place in the trued-up slot. The cutting tool *C* was set central with the shaft by means of a



Cutting Keyways in Opposite Sides of a Long Shaft

dial indicator, clamped to a small parallel which was held first against one side of the shaft and then against the other, the tool being adjusted until the indicator registered the same on each side. The first keyway was then cut to the required depth.

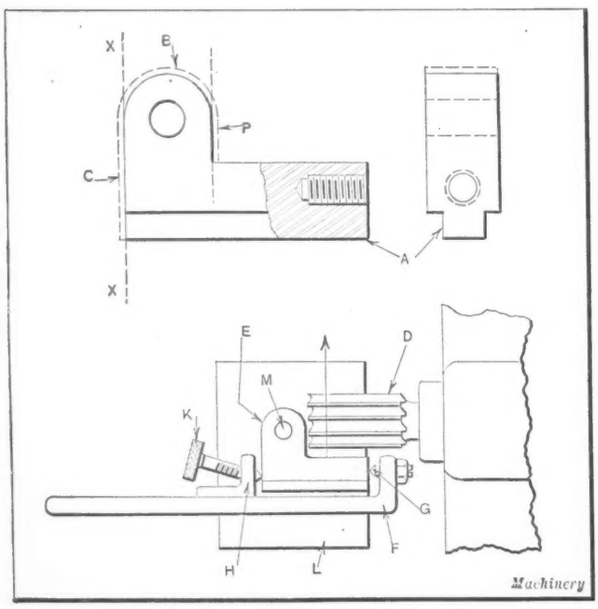
The shaft was next removed, and a cast-iron block *D*, about 4 inches long, was driven down into one end of the planer T-slot. Then, without shifting the cutting tool a slot or keyway was cut in the cast-iron block, after which the key *E* was carefully fitted in the slot and the shaft put back in place on the planer table. The keyway of the shaft, fitting over the key *E*, served to locate the shaft in the proper position for cutting the second keyway. The finished shaft was found to be a good fit in the broached holes of the gears and no trouble was experienced in sliding any of the gears the full length of the shaft.

Cleveland, Ohio CHARLES OWEN LEWIS

MILLING A CURVED SURFACE WITH AN END-MILL

Work that goes through the shop in a hurry is likely to suffer from too much haste, and when the parts are assembled it may be found that they will not fit properly. The writer saw a case of this kind a short time ago. The work that was wanted in a hurry consisted of a small brass casting like the one shown at *A* in the illustration. About 100 of these pieces were made up on very short notice to be shipped as soon as possible. Through an error in making the pattern the castings had an excess amount of stock at *B*, *C* and *P*, so that when an attempt was made to assemble the parts serious interference was encountered. There was no time to make a form cutter, and nothing was available in the tool-crib that was anywhere near the size that was required.

The work was done rapidly in the following manner and rushed to completion. The portion *C* was milled away on



Milling a Curved Surface with an End-mill

line *X-X* by holding the work in a vise mounted on a hand milling machine. While this was being done by another man the writer found a cast-iron plate *L* and drilled a couple of holes in it so that it could be fastened to the milling machine table. A drill rod plug *M* of suitable size was driven into plate *L*. A ¼- by 1-inch strap *F* was bent as shown, and a pointed pin *G* inserted at one end. A short piece of stock was bent and fastened at *H* so that the thumbscrew *K* could be applied to this end of the work to clamp it to the handle.

The work *E* was placed on the stud *M* and an end mill *D* used in the spindle of a hand milling machine. The table was fed forward in the direction indicated by the arrow to finish the side of the work at *P*. The lever *F* was then pulled around by hand to generate the curved surface at *B*. By this makeshift method the work was gotten out in time for shipment and within a sufficient degree of accuracy to meet requirements. ALEX DOWEL

ALIGNING STOCK GUIDE OPENING IN STRIPPER PLATE

The proper alignment of the stock guide opening in the stripper plate of a progressive die is often a puzzling problem, and few diemakers have any definite method of accomplishing this. If the stock guide is not properly aligned,

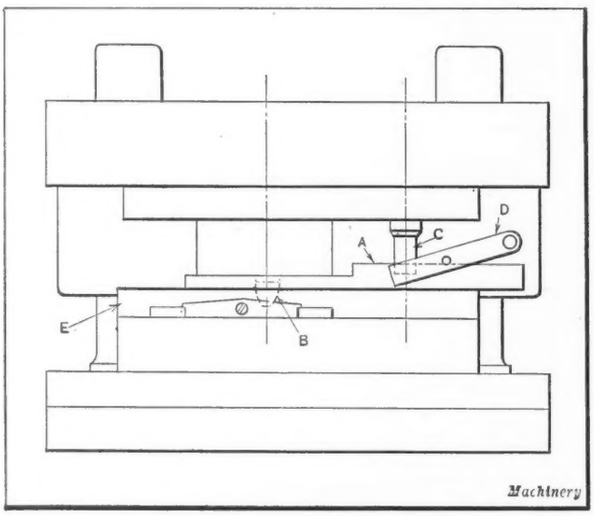


Diagram showing Method of aligning Stock Opening in Stripper Plate

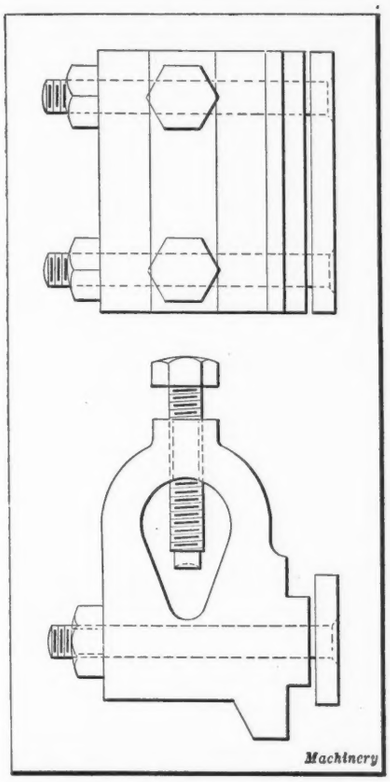
the stock will be pulled over by the pilots. The accompanying illustration shows a simple method of obtaining accurate alignment. With this method a strip *A* having an offset is used. The thin end of this strip is located against the pilot *B*, and the heavy end is placed against the corresponding perforating punch *C*. A pair of small parallel clamps *D* may be used to hold the strip *A* in position.

After clamping the strip in place, the die is closed, as shown in the illustration, and a line scratched on the stripper plate *E*, using the edge of strip *A* as a guide. This line makes it a very simple matter to set up the work properly for machining the opening for the stock. The accurate location of the stock guide slot by this method will save many broken pilots and eliminate much repair work. When this method is employed the die does not need to be finished on any of its sides to facilitate laying out the work as it is commonly done. On work that does not require great accuracy, it is simply necessary to lay a templet on the die and drill the required holes.

The offset strip *A* is also of value in testing the alignment of dies which do not function properly. For this work, a line is first scribed on the stripper plate, as previously described. The stripper plate is then mounted on an angle plate, where it is aligned in a horizontal position, using the scribed line as a guide. The parallelism of the stock opening with respect to the scribed line is tested by running an indicator along the edge of the stock opening. If it is found necessary to remachine the stock opening in a shaper or milling machine, the scribed line is simply transferred to the opposite side of the plate by means of a surface gage while the stripper is mounted on the angle-plate. The vise of the machine can then be swung to whatever angle is required to machine the opening parallel with the scribed line.

St. Louis, Mo. HARRY B. HANSEN

Shop and Drafting-room Kinks



Holder for Boring-bars of Various Diameters

BORING-BAR HOLDER

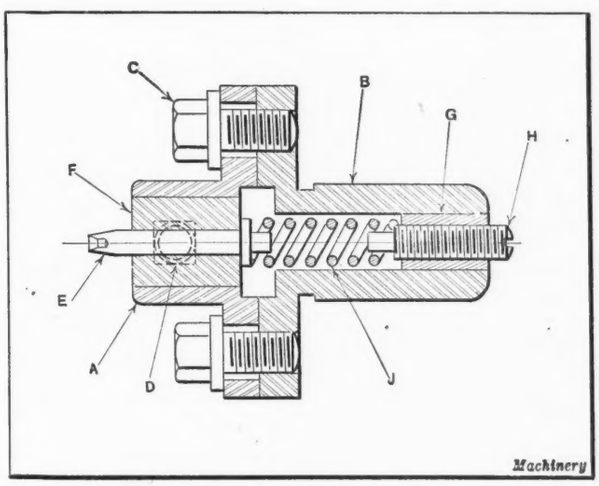
The accompanying illustration shows a boring-bar holder designed for use on a lathe. It is clamped to the compound rest, and a slot of special shape is cut in it so that boring-bars of various diameters can be accommodated and held in place by the screws. The simplicity of the construction and the range of work for which it may be used will be apparent to those familiar with the use of a device of this kind. The substantial construction and method of attaching this device make it well suited for heavy work.

E. W. CABLE
Butte, Mont.

SCREW MACHINE WORK SUPPORT

An adjustable work support for an automatic screw machine is shown in the accompanying illustration. This support has proved useful in tooling up a No. 00 B & S machine for handling small work, the hole in the end of support *E* being 1/16 inch deep and 0.028 inch in diameter. Parts *A*, *B*, *C*, and *D* are standard products of the Brown & Sharpe Mfg. Co. Parts *A* and *B* must, of course, be machined to receive the other parts of the tool-holder.

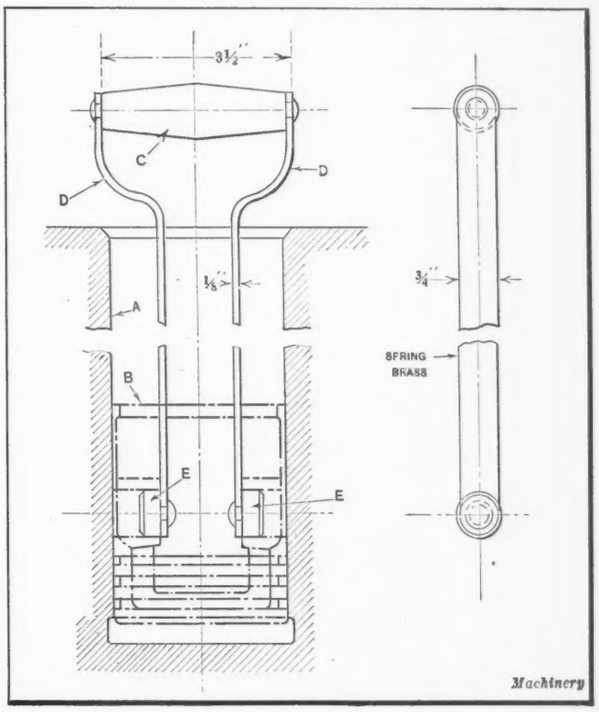
The tool-steel piece *F* is hardened and ground to a snug fit in part *A*. The tool-steel support *E* is also hardened and ground and is a sliding fit in part *F*. Brass bushing *G* is a driving fit in part *B*. Spring *J* is adjusted by screw *H*. The size of the wire used for the spring depends upon the kind and size of stock being operated on. E. W. L.



Work Support for Automatic Screw Machine

TONGS FOR FITTING PISTONS IN CYLINDERS

The tongs shown in the accompanying illustration are designed to facilitate sliding a piston up and down in a cylinder block when fitting the piston to the cylinder bore. The cylinder bore is shown in section at *A*, while the piston is represented by dot-and-dash lines at *B*. The tongs are made up of a handle *C* and two straps *D* made of spring



Tongs used in fitting a Piston in a Cylinder

brass. To the end of each of the spring straps is riveted a small plug *E*. These plugs are made about 0.005 inch smaller than the wrist-pin hole so they can be easily inserted. In attaching the tongs to the piston, it is only necessary to press the two straps together, insert the ends in the piston, and then allow the straps to spring back so that the plugs *E* will enter the wrist-pin holes.

Pittsburg, Pa. WILLIAM OWEN

HOLDER FOR PENS

Lettering and ruling pens, as well as writing pens, may be kept in first-class condition when not in use, by thrusting them into a jar of BB shot which has been moistened with castor oil. The oil-covered surface of the shot supplies just enough oil to prevent ink from drying on the pens, thus eliminating the principal cause of corrosion or rust. When kept in such a holder, the pens will be shiny and clean each time they are removed and wiped for use.

Auburndale, Mass. FRANK H. JONES

Questions and Answers on Practical Subjects

TANGENCY PROBLEM

P. L. W.—Referring to the accompanying diagram, please show how to calculate the radius r of a circle which passes through point C of square $ABCD$ and is tangent to the sides AD and AB? The dimension a of the square is known.

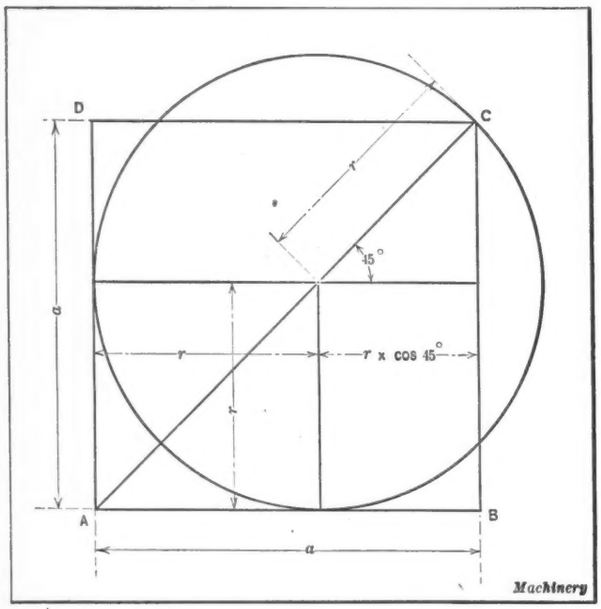


Diagram used in solving Tangency Problem

A.—Referring to the diagram,

$$a = r + r \times \cos 45 \text{ degrees}$$
$$= r\ (1 + \cos 45 \text{ degrees})$$

Hence

$$r = \frac{a}{1 + \cos 45 \text{ degrees}}$$

SIZE OF TAP DRILLS

H. S. A.—What is the correct relation between the diameter of a tap and the drill which precedes it, and to what extent is the size affected by different materials?

A.—There is some variation in the practice of different manufacturers even when tapping the same general class of work, but as a general rule, in manufacturing practice, the drilled holes are large enough to allow for a tapped thread having a depth equal to about three-fourths of the standard depth. On certain classes of work, one-half of the standard thread depth is considered sufficient. So far as strength is concerned, threads tapped to one-half the standard depth are satisfactory; in fact, a bolt subjected to an axial load will break instead of stripping the threads; this applies to a U. S. standard thread inserted in an ordinary cold-punched nut.

When tapping soft material such as copper, drawn aluminum or Norway iron, the holes should be somewhat larger than in the case of harder crystalline materials such as cast metal. If the holes in the soft tough materials are too small, the tops of the threads are likely to be torn off, so that the effective depth of the thread is really less than it would be if the hole were originally larger. Generally speaking, it is safer to drill tap holes too large rather than too small, because three-fourths of a full bearing will give all the strength required.

DESIGNER'S PROBLEM

C. K.—Please show how to find angle x in the accompanying diagram. This angle is required in working out the design of steel wheels.

A.—To find angle x as indicated in the diagram, first draw lines AB, AD, and EB. We now have two right-angle triangles, ACD and ECB.

Now

$$AB = \sqrt{AF^2 + FB^2}$$
$$\text{Sin } a = \frac{AD}{AC} = \frac{EB}{CB}$$
$$AC + CB = AB$$

Therefore,

$$\text{Sin } a = \frac{AD + EB}{AB}$$
$$\text{Sin } b = \frac{AF}{AB}$$
$$\text{Angle } e = 180 \text{ degrees} - (a + b)$$
$$x = 90 \text{ degrees} - e$$

Substituting the numerical values given in the diagram, we have

$$AB = \sqrt{3.75^2 + 3.1875^2} = 4.92165$$
$$\text{Sin } a = \frac{3 + 1.625}{4.92165} = 0.93972$$
$$a = 70 \text{ degrees } 18 \text{ seconds}$$
$$\text{Sin } b = \frac{3.75}{4.92165} = 0.76194$$

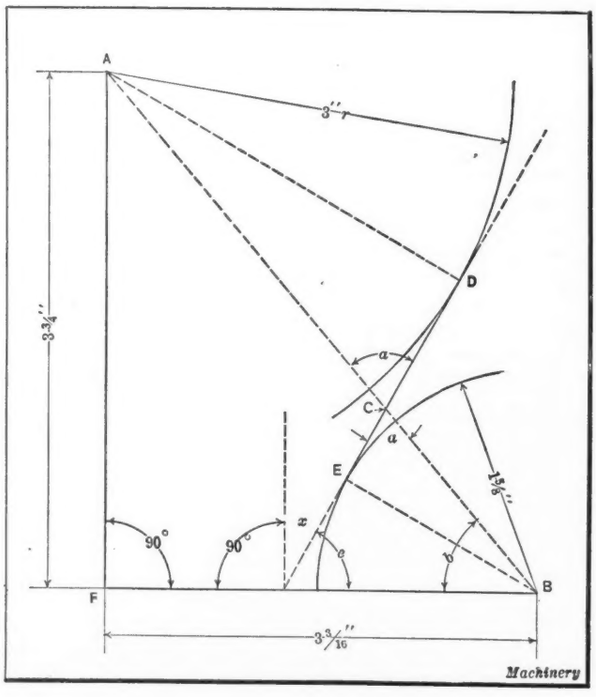


Diagram for solving a Designer's Problem

$b = 49$ degrees 38 minutes 9 seconds

Therefore

$e = 180$ degrees — (70 deg. 18 sec. + 49 deg. 38 min. 9 sec.)
$= 60$ degrees 21 minutes 33 seconds

and

$x = 90$ degrees — (60 deg. 21 min. 33 seconds)
$= 29$ degrees 38 minutes 27 seconds

ALLOWANCES FOR SHRINKAGE FITS

By A. DESIGNER

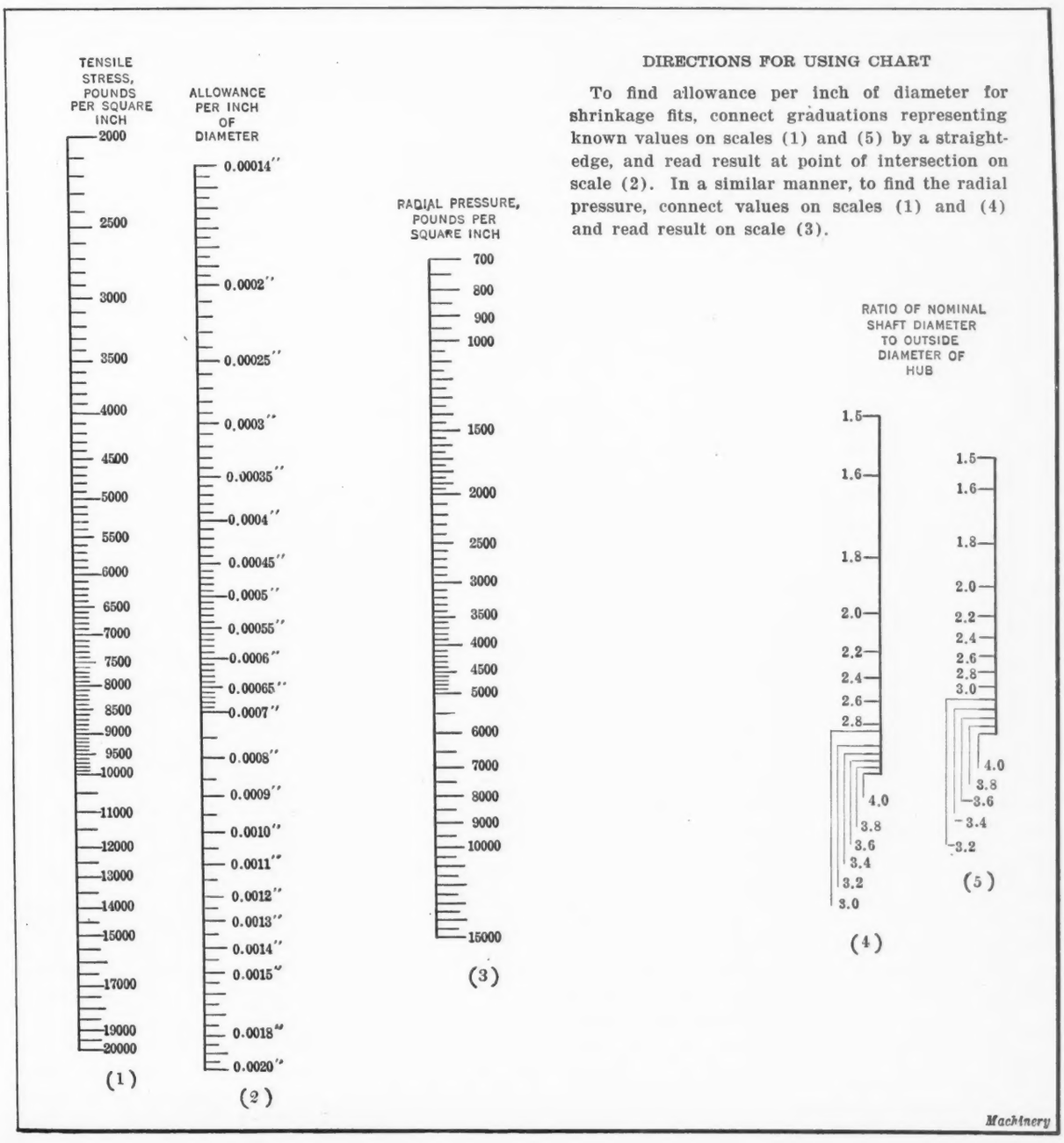
In calculating shrinkage fits, there are two main factors to be considered. The first and most important is the stress in the hub at the bore, which depends chiefly upon the shrinkage allowance. If the allowance is too large, the elastic limit will be exceeded and permanent set will occur; or, in extreme cases, the ultimate strength of the metal will be exceeded and the hub will burst. The second factor may be referred to as the intensity of the grip of the fit, which depends chiefly upon the thickness of the hub; the greater this thickness, the stronger the grip, and vice versa.

The formulas given in MACHINERY'S HANDBOOK on page 886 for determining the allowance per inch of diameter to be made for shrinkage fits, have been used in developing the accompanying chart. This chart is for use when the hub is of cast iron and the shaft of steel. A similar chart (not shown) has also been worked out by the author for use when both the hub and the shaft are of steel. Besides giving the allowance per inch to be made, the chart also gives the radial pressure resulting from the intensity of the grip of the fit, the formula being obtained from MACHINERY'S Reference Book No. 89.

To illustrate the use of the chart, let us assume that we have a cast-iron hub and a steel shaft, the internal and external diameters of the hub being in the ratio of 1 to 1.5. The tensile stress in the hub, which is of cast iron, may be taken as 4000 pounds per square inch. The problem is to determine the amount of allowance per inch for a shrinkage fit. First lay a straightedge across the chart, connecting 4000 on the tensile stress scale with the ratio 1.5 on the scale marked (5). Then on scale (2) read the allowance per inch, which in this case is between 0.00029 and 0.0003 inch. In practice, the latter value would no doubt be used.

The magnitude of the radial pressure exerted by the fit is next desired. The formula for this is $P = TC$, where P = radial pressure; T = tensile stress of the material used; and C = a constant which is dependent upon the ratio of the external and internal diameters. Then, by connecting the

CHART FOR DETERMINING ALLOWANCE PER INCH OF DIAMETER FOR SHRINKAGE FITS AND THE RESULTING RADIAL PRESSURE WHEN THE HUB IS CAST IRON AND THE SHAFT STEEL



tensile stress, 4000 pounds in this case, with the same ratio, 1.5 on scale marked (4), we read, on scale (3), 1400 pounds as the radial pressure exerted by the fit.

A little study of the chart will disclose some interesting facts that are not so apparent when use is made of tabulated values. For example, if we increase the tensile stress in the hub to 6000 pounds per square inch, maintaining the same diameter ratio, the resulting allowance per inch of diameter is increased to 0.00044 inch and the radial pressure correspondingly increased to approximately 2100 pounds. On the other hand, if we, arbitrarily, adopt an allowance of say 0.001 inch per inch of diameter, it is found that with the same ratio the tensile stress is jumped up to 13,500 pounds per square inch and the radial pressure is increased to 4700 pounds per square inch.

It can readily be seen that the determination of the allowance for this class of fits should be given careful thought in order to prevent the ultimate strength of the material and its elastic limit from being exceeded. To approach the danger point too closely invites trouble. It will be evident that the chart can be worked inversely, that is, if the allowance is known, the radial pressure or tensile stress can be determined. It is necessary, however, that two of the factors be known, or assumed, in order to find the third.

* * *

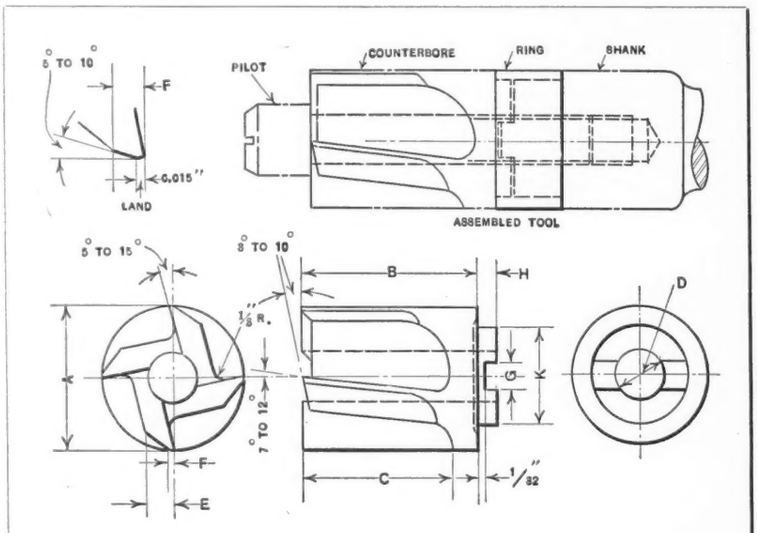
In equipping a plant and in buying new machinery, great care is usually taken to see that the best machine for the purpose is obtained. The buying of small tools and tooling equipment is not always done with the same care; yet small tools very largely determine manufacturing costs. In plants where quantity as well as quality of the product is the main consideration, the same care should be given to obtain the most effective tooling equipment as is given to the selection of machine tools. As a rule, it requires more definite knowledge of machining methods and of tools available in the market to properly select a tooling equipment than it does to select a machine tool. In some shops, all tools are passed upon by a special department, whether the tools are bought from the outside or designed and made in the tool-room of the shop. Such a tool ordering and inspection department insures uniformity and makes it possible to have someone who is constantly looking out for the quality and type of tooling equipment used. This system can also be extended to the care for the entire tooling equipment.

COUNTERBORES OR SPOT-FACING TOOLS WITH INTERCHANGEABLE CUTTERS

By EDWARD H. TINGLEY
Research Engineer, Delco Light Co., Dayton, Ohio

The counterbores or spot-facing tools described and illustrated in this article were developed for use in the plant of the Delco Light Co., Dayton, Ohio, where they have been employed for a long time with marked success. In working out the design of the various members composing these tools, especial care was taken to eliminate certain sources of trouble found to exist in the usual type of counterbore. For instance, the pilots of regular tools frequently become loose and when this happens the workmen usually rough up the pilot stem and drive it back into place. Naturally this treatment often causes the pilot to run out of true with the body of the counterbore. Then again many counterbores are broken by the workmen in their efforts to press the pilots in hard enough to make them stay in place. It is the elimination of troubles of this kind that has made the new tools so successful.

TABLE 1. DIMENSIONS OF COUNTERBORES OR SPOT-FACING TOOLS



No.	A	B	C	D	E	F	G	H	K
1	0.750	1 1/8	3/4	0.312	7/32	1/16	0.255	5/32	0.624
2	0.7812	1 1/8	3/4	0.312	7/32	1/16	0.255	5/32	0.624
3	0.8125	1 1/8	13/16	0.312	7/32	1/16	0.255	5/32	0.624
4	0.8437	1 1/8	13/16	0.312	7/32	1/16	0.255	5/32	0.624
5	0.875	1 1/8	7/8	0.312	7/32	1/16	0.318	3/16	0.686
6	0.9062	1 5/16	7/8	0.312	7/32	1/16	0.318	3/16	0.686
7	0.9375	1 3/8	13/16	0.312	7/32	1/16	0.318	3/16	0.686
8	0.9687	1 3/8	15/16	0.312	7/32	1/16	0.318	3/16	0.686
9	1.000	1 7/16	1	0.312	7/32	1/16	0.318	3/16	0.874
10	1.0625	1 7/16	1	0.312	7/32	3/32	0.318	3/16	0.874
11	1.125	1 11/16	1 1/8	0.312	7/32	3/32	0.318	3/16	0.874
12	1.1875	1 11/16	1 1/8	0.312	7/32	3/32	0.318	3/16	0.874
13	1.250	1 13/16	1 1/4	0.437	9/32	3/32	0.380	7/32	1.061
14	1.375	1 13/16	1 1/4	0.437	9/32	3/32	0.380	7/32	1.061
15	1.500	2 1/16	1 1/2	0.562	11/32	1/8	0.380	7/32	1.249
16	1.625	2 1/16	1 1/2	0.562	11/32	1/8	0.380	7/32	1.249
17	1.750	2 5/16	1 3/4	0.562	11/32	1/8	0.380	7/32	1.499
18	1.875	2 5/16	1 3/4	0.562	11/32	1/8	0.380	7/32	1.499
19	2.000	2 5/16	1 3/4	0.562	11/32	1/8	0.380	7/32	1.499

Machinery

The complete tool consists of a counterbore, a pilot, an adapter ring and shank, as shown in the assembly view that accompanies Table 1. The data in Tables 1 and 2 give the various dimensions of all the parts required in covering a wide range of sizes.

It will be noted that many dimensions of these parts are the same for different sizes. This makes the parts interchangeable and also reduces the total number of parts actually required. These counterbores are comparatively inexpensive to manufacture, as very little tool steel is necessary. The tool can be disassembled easily at any time by simply unscrewing the pilot.

It will be noted that the flutes of the cutter shown in connection with Table 1 follow the path of a right-hand helix, which gives the cutting edges a positive shear. The flutes may, of course, be cut to conform to a left-hand helix, or spiral, when conditions require a cutter having a negative shear. Thread *N* (see Table 2) is made rather a loose fit for the thread in the shank of the tool. This permits the accurately turned body section *M* to center the pilot exactly in the cutter.

* * *

The most important news in the automobile field has been the $80,000,000 merger of manufacturers of automobiles, trucks, and parts under the name of the Associated Motor Industries, with factories in seven states.

REMOVING DENTS FROM METALLIC SHELLS

By A. EYLES, Foreman Sheet Metal Worker
Lancashire & Yorkshire Railway, Manchester, England

The article relating to the removal of dents from metallic shells, which appeared on page 101 of October, 1921, MACHINERY, was of great interest to the writer, because removing and straightening out dents in metallic shells, closed cylindrical vessels, automobile lamps, brass musical and scientific instruments, tubing, sheet-metal parts of damaged automobiles, etc., is an important part of the work in the sheet-metal shop where the writer is employed. The following practical hints for removing and straightening out the dents on metallic objects may be of interest to readers employed in various branches of engineering:

In general practice, it is found best to anneal the metal in the immediate vicinity of the damaged part, in order to insure an equal flow and to minimize any possibility of cracking. If the shell or vessel is made from copper, the damaged part should be annealed by being heated to a dull red color, and then instantly plunged into cold water. Copper or brass shells should never be annealed in a freshly made coke fire. The blast should be turned on until the fire is incandescent, as otherwise the sulphur in the coke will affect the quality of the copper. Again, it is not advisable to work thin copper while it is hot. Iron and mild steel shells can be worked on much better when hot, but it may be ruinous to work on copper in a similar manner; this also applies to aluminum, brass, and zinc articles.

Methods of Annealing

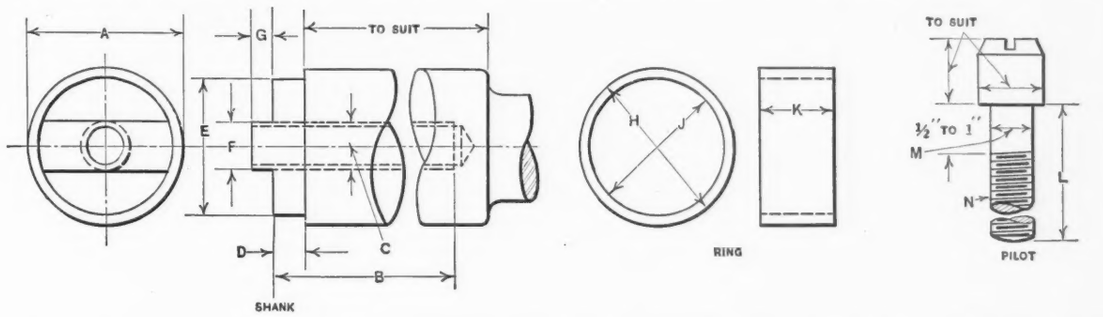
Brass shells require very careful annealing in order to prevent the metal from being overheated and becoming brittle. Some kinds of brass will even crumble while in a red hot state if touched with a hammer. As regards the method or rate of cooling brass after it has been annealed (the metal must not be heated above a dull red color) the writer invariably finds that on hard worked or hardened sheet brass, such as is generally used for intricate stampings, spinnings, etc.; the most favorable conditions are obtained when the metal is cooled slowly in the atmosphere.

Aluminum shells require less annealing than brass shells. The metal should be heated to a very dull red color (which is perceptible only in the dark) and then cooled slowly. A suitable annealing temperature varies from 700 to 900 degrees F., depending on the thickness of the metal and the length of time it is subjected to the heat. Metallic shells, etc., made from tin and terne-plates, and electroplated ware cannot be satisfactorily annealed, as their protective coatings will be destroyed by the heat.

Removing Dents from Thin Shells

If the shell is made from very thin sheet metal and if there is no means of working from within, a piece of stout wire should be soldered to the shell in the center of the dent. After the solder has set, the wire can be given a strong pull so that the metal will be pulled outward. The wire can then be melted off. A wire bent to form a handle will be found to be a useful tool for this work, and it can be kept on hand ready for the next job. Sometimes when the dent is not eliminated satisfactorily by this method, a few light blows with a flat-faced bright hammer delivered around the dent will greatly improve the appearance of the piece. If a polished brass article has been dealt with, such as a brass musical or scientific instrument, very fine emery cloth should be used to remove every trace of solder, afterward rottenstone and oil, or tripoli and oil should be used, finishing off with dry powdered lime. Buffing is used, of course, whenever highly polished surfaces are required.

TABLE 2. DIMENSIONS OF COUNTERBORE SHANK, RING, AND PILOT



Shank								Ring			Pilot		
No.	A	B	C	D	E	F	G	H	J	K	L	M	N
1	3/4	1 1/4	5/16-18	1/4	0.625	0.250	1/8	3/4	0.625	7/16	1 7/8	0.311	5/16-18
2	25/32	1 1/4	5/16-18	1/4	0.625	0.250	1/8	25/32	0.625	7/16	1 7/8	0.311	5/16-18
3	13/16	1 1/4	5/16-18	1/4	0.625	0.250	1/8	13/16	0.625	7/16	1 13/16	0.311	5/16-18
4	27/32	1 1/4	5/16-18	1/4	0.625	0.250	1/8	27/32	0.625	7/16	1 13/16	0.311	5/16-18
5	7/8	1 1/4	5/16-18	1/4	0.687	0.312	5/32	7/8	0.687	15/32	2 1/16	0.311	5/16-18
6	29/32	1 1/4	5/16-18	1/4	0.687	0.312	5/32	29/32	0.687	15/32	2 1/16	0.311	5/16-18
7	15/16	1 1/4	5/16-18	1/4	0.687	0.312	5/32	15/16	0.687	15/32	2 1/8	0.311	5/16-18
8	31/32	1 1/4	5/16-18	1/4	0.687	0.312	5/32	31/32	0.687	15/32	2 1/8	0.311	5/16-18
9	1	1 1/4	5/16-18	11/32	0.875	0.312	5/32	1	0.875	9/16	2 3/16	0.311	5/16-18
10	1 1/16	1 1/4	5/16-18	11/32	0.875	0.312	5/32	1 1/16	0.875	9/16	2 3/16	0.311	5/16-18
11	1 1/8	1 1/4	5/16-18	11/32	0.875	0.312	5/32	1 1/8	0.875	9/16	2 7/16	0.311	5/16-18
12	1 3/16	1 1/4	5/16-18	11/32	0.875	0.312	5/32	1 3/16	0.875	9/16	2 7/16	0.311	5/16-18
13	1 1/4	1 5/8	7/16-14	11/32	1.062	0.375	3/16	1 1/4	1.062	19/32	2 3/4	0.436	7/16-14
14	1 3/8	1 5/8	7/16-14	11/32	1.062	0.375	3/16	1 3/8	1.062	19/32	2 3/4	0.436	7/16-14
15	1 1/2	2	9/16-12	3/8	1.249	0.375	3/16	1 1/2	1.250	5/8	3 3/16	0.561	9/16-12
16	1 5/8	2	9/16-12	3/8	1.249	0.375	3/16	1 5/8	1.250	5/8	3 3/16	0.561	9/16-12
17	1 3/4	2	9/16-12	3/8	1.499	0.375	3/16	1 3/4	1.500	5/8	3 7/16	0.561	9/16-12
18	1 7/8	2	9/16-12	3/8	1.499	0.375	3/16	1 7/8	1.500	5/8	3 7/16	0.561	9/16-12
19	2	2	9/16-12	3/8	1.499	0.375	3/16	2	1.500	5/8	3 7/16	0.561	9/16-12

Machinery

If the shell has an opening at one side large enough to permit a suitable tool to enter, the dent or bulge can be straightened out by hammering, the projecting dent inside the shell being hammered back by placing the shell on an iron stake and manipulating the hammer so that while the dent rests on the stake the blows will be delivered on each side of it, or around it. Persistent and judicious hammering will force the dent out until the original shape is restored.

Filling up Dents

In some cases it is more economical to load the dent up with solder and smooth it with a file or scraper, and sandpaper, or to solder a patch of metal over the damaged part, after which the soldered part can be filed or ground down until the shell resumes its original appearance. The indented surfaces to be soldered and the adjacent metal must be thoroughly cleaned before attempting to solder. When a patch is employed, it should be held down during the soldering process, say with an old file, which should not be removed until the solder is firmly set. All traces of the flux used for soldering should be thoroughly washed off to avoid subsequent corrosion of the metal.

Removing Dents from Tubing and from Spherical Shells

Another method of eliminating dents in metallic shells of small diameter, such as tubing, etc., is to obtain a number of steel balls, highly polished, and equal in diameter to the inner diameter of that part of the shell or tubing which is undamaged. Anneal the damaged part, as previously explained, and then drive the balls throughout the entire length of the shell or tube. A little powdered black lead sprinkled among the balls in the shell will facilitate the work. Obviously, if the balls can be made to pass through the shell, the latter will be restored to its original shape. If steel balls are not available, hard wooden balls may be used; but these, of course, will not produce as good a job if stout metal is being handled.

Dents on tubing such as used in the manufacture of microscopes, telescopes, etc., can be removed by laying the tube on the surface of a piece of hard wood, and, with either a burnisher or a round piece of hard wood, rubbing the inside of the tube over the indentations, which will quickly bring the indented surface up level.

In some cases, it is possible to remove a dent from a spherical shaped shell by lightly hammering the outer edge of the dent with a smooth-faced hammer until the indentation disappears. The degree of success of this operation will depend, of course, on the thickness and characteristics of the metal, and the skill of the workman. Dents from 6-inch copper floats have been eliminated by this method.

Removing Dents from Car Roofs

The writer has recently been employed in removing dents from the metal roofs of a number of all-metal railway vehicles. The roof material was sheet aluminum, 0.080 inch thick, and the indentations in many cases had a surface of 500 square inches. For this work a hard wood block provided with a handle and shaped to conform with the curved part was used. This block was employed on the inside of the vehicles for forcing the aluminum upward. The dents were removed by carefully manipulating the wooden block and judiciously hammering the metal on the outside of the roof to get the metal to flow from one point to another. To secure a smooth surface and to harden and stiffen the metal, the surface was finished off with a flat-faced bright hammer over a smooth iron tool.

Another unusual job was the straightening out of the dents on a number of aluminum closed cylindrical vessels, 4 feet long by 2 feet in diameter and 0.128 inch thick, with riveted joints and flanges attached. The vessels were badly damaged, and it was therefore necessary to take one of the dish-shaped ends out of the vessel. The dents and buckled parts were easily straightened out with a wooden mallet over an iron stake, after the metal had been annealed well, the surface being smoothed by hammering with a smooth faced hammer.

To make the vessels air-tight again, ¼-inch aluminum rivets of the cup-head type were used, together with a suitable layer of canvas and paint carefully placed between the cylinder portion and the dished end. Sometimes when removing dents from sheet-metal automobile parts, special iron blocks of different radii are necessary. Good results are usually obtained by holding a suitable iron block on the inside and striking on the outside with a flat-faced bright hammer. In all cases, when removing dents from metal surfaces, care must be taken to bring the hammer flat on the face of the work every time, particularly so when smoothing or planishing the metal surface; otherwise, "half-moons" will appear, and it will be impossible to obtain a perfectly smooth and level surface. Success in using the hand hammer in smoothing or planishing metal surfaces can only be acquired by practice, and written instructions are useless without practice.

* * *

MAKING JOURNAL BRASSES

By M. E. DUGGAN

When only a few journal brasses of the type shown in Fig. 1 are required it is common practice to make a single pattern from which to produce the castings, but if a large number are to be produced, a double pattern is usually made to permit molding, casting, and machining the brasses in pairs. When a single pattern is employed the pouring is

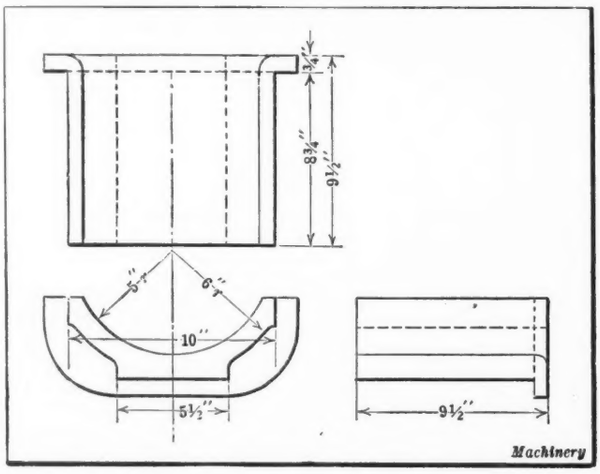


Fig. 1. Journal Brass to be produced

done with the mold lying flat or so that the casting will be in the position indicated by the lower view in the illustration Fig. 1.

Four different methods of tying or connecting two single patterns to form a double pattern are shown in Fig. 2. In this illustration, corner sections of the four differently constructed patterns are shown grouped about a common center, so that the construction details of the four types can be easily compared. The section of the pattern shown in the upper left-hand corner is attached to the mold board *F*. This type of pattern is objectionable, because when the drag flask with the pattern inside is rolled over and the mold completed ready to draw the pattern, the view is obstructed by the mold board, thus forcing the molder to depend on his sense of feeling when drawing the pattern.

Another objection to this pattern is that the castings produced by its use could not be bored out in the shop without cutting through the tie-sections. In one instance a pattern made in this way was returned to the patternmaker with the request that the tie-piece be so changed that the brasses could be bored in pairs without cutting through the tie-

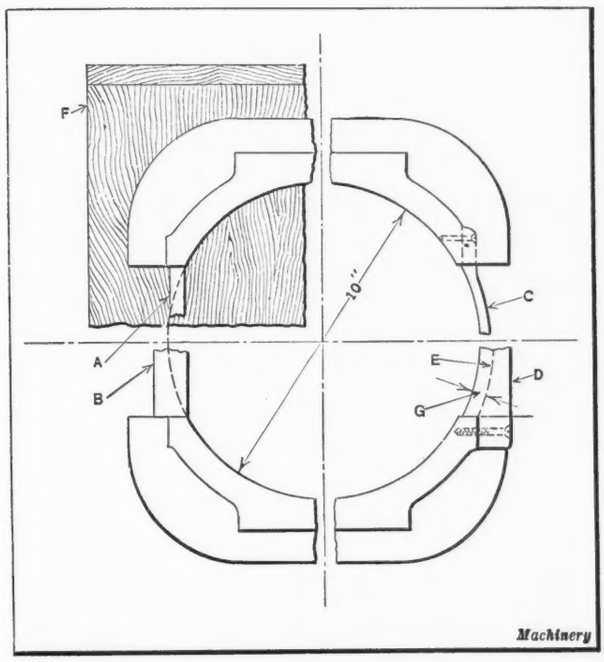


Fig. 2. Four Methods of tying Single Patterns together for casting Journal Brasses in Pairs

pieces. The change was made by simply adding more material to the outside of the tie-pieces, thus increasing the thickness as shown in the lower view at *B*. This method of correcting the pattern was not satisfactory, as it left too much metal to be removed from the brasses by the boring operation.

The pattern shown in the upper right-hand corner is provided with a tie-piece *C* made of finished brass and attached to the wooden pattern by screws. It will be noted that this piece is very thin and that it is made circular in form and set back from the inner surface of the bore slightly so that the boring tool will not touch the tie-pieces when the castings are being bored. The only objection to this method of tying the two single or half patterns together is that the wood-screws will become loosened after a time.

The writer believes that the most satisfactory method of tying the half patterns together is that illustrated in the lower right-hand corner. This method meets every requirement of the molder and machinist. With this type of pattern the two half patterns are connected at each side by hard wood blocks. The lower section of one of these blocks is shown at *D*. They are made flush with the flange and form both the pattern and the core-print. These blocks are carefully fitted to the pattern, and are secured in place with glue and screws. The inner circular surface of the blocks can be made flush with the bore of the pattern or cut back to give clearance for the boring tool. The dry sand core used in this case is made the same shape as block *D* except that its inner surface is cut back as indicated by the dotted line *E* so that the thickness of the tie-piece connecting the two halves of a journal brass casting made from this mold is represented by dimension *G*. In some shops, it is the practice to cut the tie-sections out after the brasses have been bored, and finish machining the parts separately, while in other shops as much of the machining work as possible is performed before cutting the halves apart.

* * *

MARCONI RECEIVES JOHN FRITZ MEDAL

The John Fritz medal, one of the highest distinctions bestowed by the engineering profession in this country upon a fellow engineer was awarded to Guglielmo Marconi, the inventor of wireless telegraphy, at a meeting held in the Engineering Societies' Building, New York City, July 6.

LATHE SET-UP FOR VARYING LEAD

By O. S. MARSHALL

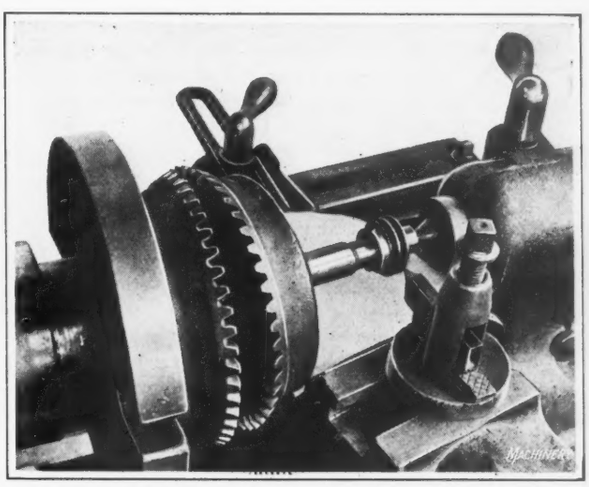
The usual method of obtaining the correct lead when cutting screw or worm threads is to have the right combination of simple or compound gearing between the lathe spindle and the lead-screw. If the occasion arises for cutting some lead for which gears do not happen to be available, it is the usual practice to make or buy one or more gears which will give the required ratio. At least one manufacturer provides his lathe (through the English and the metric gear combinations and an accompanying chart) with a means of cutting a great variety of fractional leads. This is satisfactory where an elaborate equipment is not objectionable. In some cases, however, more simple and less expensive equipment must be used. Then any modern engine lathe provided with a taper-turning attachment will be found to give equally accurate results without the use of other gears than those normally provided.

Cutting Fractional Leads

The necessity of cutting fractional leads frequently occurs in connection with the machining of helical gears having an extreme helix angle which may often approach that of a coarse lead-screw. Such gears may resemble a worm in appearance except for their tooth form. When, as frequently happens, the lead is finer than can be generated on a milling machine, the engine lathe can be used with perfectly satisfactory results. The limit of milling machines in the matter of short leads is generally 0.600 to 0.670 inch. It is inadvisable to undertake anything finer than this on the milling machine, and unless a regular gear-hobbing machine and a suitable hob is in stock—which is improbable—the engine lathe is naturally the machine to use.

A job repeatedly performed on an engine lathe, which is described in the following, will serve to illustrate the method. The work in this instance is a helical gear which is shown mounted on lathe centers in the accompanying illustration. The pitch diameter is 1.652 inches, and the helix or lead 0.3144 inch. The gear is 10 pitch and has one tooth only, of spur gear form. It resembles an ordinary worm, but is calculated strictly according to helical-gear formulas, which require close adherence to the correct angular relationship with the pitch diameters when the center distances are not susceptible of alteration.

The reader must keep clearly in mind the significance of the terms "pitch" and "lead" as applied to helical gears, and not confuse them with similar terms applied to either worms or screws. The helical gear shown in the illustration has the appearance of a worm, as previously mentioned, and it functions like one, but it meshes with another 10-pitch helical gear. This gear has twenty-five teeth and a pitch diameter of 2.534 inches. The helix angle of the 25-



Lathe Set-up for obtaining Variation in Lead

tooth gear is 3 degrees 28 minutes, while the helix angle of the single tooth gear to be cut is 86 degrees 32 minutes.

Setting up the Engine Lathe

It is first necessary to determine if the engine lathe will function satisfactorily in performing work for which a milling machine cannot be used because of its limitations in cutting fine leads. The engine lathe is handicapped, however, in the matter of cutting excessively coarse leads. As it is not permissible or good practice to pass a "drunken" thread, it is essential to provide some means of driving the work uniformly throughout every part of its rotation. This is done by the use of a pair of bevel gears, so cut that they will allow a variation of about 5 degrees in their pitch-cone relationship and still operate smoothly when in mesh as shown.

If gears such as those shown are not easily obtainable, a simple plate with six or eight holes drilled to receive driving studs may be attached to the regular driving plate of the lathe. A special flanged arbor provided with corresponding pins is employed to carry the work. The number of driving pins used will depend upon the degree of refinement required in the work. The greater the number of pins used, the more complete will be the elimination of minute inequalities in the lead.

The next step is to determine the lead or helix of the blank and note its nearest approach to some lead which the lathe will cut with its regular gears. The gears selected should give a lead shorter than the one to be cut but as near to that of the required helix as possible. The reason for this will appear in the following: The lead of the helical-gear tooth is 0.3144 inch and is found by the regular formulas for helical gear design. The engineering department ordinarily supplies this detailed information, including the properly calculated angle at which to set the taper attachment.

Referring to the screw plate of the lathe, we find that 3¼ threads per inch corresponding to a lead of 0.3077 inch is the nearest approach to the required lead of 0.3144 inch. The angular setting of the taper bar is therefore 11 degrees 51 minutes. The tailstock of the lathe with the center distances adjusted to receive the arbor on which the work is mounted must next be set parallel with the angular setting of the taper guide. An indicator should be used in connection with a straight arbor placed between centers to insure the accuracy of this setting. The compound tool-rest must also be set to approximately the corresponding angle to permit feeding the tool in during the cutting operation, as the regular cross-slide cannot be used for this purpose when the taper attachment is employed.

The reason for gearing the lathe to cut the nearest shorter lead is that by so doing the least possible set-over of the tailstock will be required. In this respect it should be borne in mind that the amount of set-over on a lathe is limited. The shorter the arbor the better, provided it allows sufficient working space. When the lathe is set up as described, and put in operation, a compound movement is imparted to the tool; that is, the lathe carriage is traversed along its fixed pathway, and at the same time the taper attachment serves to control the movement of the tool along another line, as in ordinary taper turning, except that no taper is given the work since the centers of the work-holding arbor are parallel with the angular setting of the taper guide. In other words, the cutting tool travels farther in relation to its work under these conditions than it would without the use of the taper guide, and no set-over of the tailstock. The mechanical conditions are those of the right angle triangle, in which the lathe carriage moves along the base line and the tool along the hypotenuse—conditions which are readily understood by anyone familiar with machine shop practice.

The formula for determining the angular setting of the taper attachment is simple, and is given here for the convenience of those who do not possess the usual handbooks containing this information. If the lead also is desired, it may be found by first multiplying the pitch diameter by 3.1416 and then multiplying this result by the cotangent of the tooth angle. The cosine of the angle to which the taper-turning attachment is set is obtained by dividing the lead for which the lathe is geared by the required lead. After the cosine has been obtained in this way, the corresponding angle is found by referring to a table of trigonometrical functions.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, July 10

The industrial situation in France remains rather unsettled. Iron and steel production is greatly below normal; only about one-third of the blast-furnaces are in operation. On the other hand, there is less unemployment than in the past, but work has not been resumed to such an extent that manufacturers are warranted in buying new stocks of raw materials. Briefly, while there is an improvement, it is very slight and it is not steady.

The greatest improvements are noted in the automobile manufacturing field and in the making of radio apparatus—a development largely due to the broadcasting of concert programs from the Eiffel tower. Weather reports are also broadcasted throughout France by means of radio.

Reductions in wages have caused a number of strikes, one of the more important of which is in the metal-working field in the Lille section. This strike was due to a reduction of 25 centimes per hour, and as a result 9000 men went out on strike. In the Havre section a reduction of 10 per cent in wages has caused a strike of 10,000 metal workers. Most of these strikes in the past have ended by an acceptance of the reduced wages, but with a postponement of two or three months in the application of the lower wage rate.

Government statistics indicate that during the first five months of 1922 there was a considerable decrease in the value of imports over the corresponding period of 1921; and the total amount of exports was 378,000,000 francs in excess of the imports.

The machine tool market is very dull. The war stocks and machines generally are in the hands of dealers who are disposing of them only at a very slow rate. Some manufacturers have organized their own sales service to dispose of their excess stocks of machine tools. A few of the machine tool plants are shut down on account of the present difficulties.

Some examples of prices in the small tool field may prove of interest. Carbon steel 10-millimeter twist drills (approximately ⅜ inch) are sold at 4 francs (present exchange, 34 cents); same size, high-speed steel, 8.80 francs (75 cents); one-inch size, 20.90 francs ($1.77) for carbon steel, and 57.50 francs ($4.89) for high-speed steel drills. The two-inch sizes sell at 95 francs ($8.08) and 180 francs ($15.30) respectively.

* * *

PRICES OF GERMAN MACHINE TOOLS RISING

A recent letter from a machine tool dealer in Scandinavia indicates that the prices of German machine tools are gradually rising in Germany's foreign markets. This dealer states that these prices have now reached the world price level, and in many instances they are above the prices of machine tools built in other European countries. Scandinavian machine tool dealers now look more hopefully toward the future. While at present all the Scandinavian countries suffer from a severe industrial depression, it is expected that when industrial activity returns, there will be a fair market for machine tools other than those of German make.

QUENCHING SMALL PARTS

By E. B. NICHOLS

Difficulties are frequently encountered in quenching small parts that weigh only a few pounds per hundred pieces. The main problem is to keep the parts properly separated in order to prevent excessive heating of the quenching liquid before it reaches the interior of the mass. The next point is to keep the bath of a uniform temperature so that successive batches or pieces will be cooled at the same rate. The perforations in a basket intended to receive or hold small parts must necessarily be very small. For this reason proper circulation of the liquid is seldom obtained in the usual type of quenching basket. One of the objectionable features of the usual type of basket is that the perforations in the bottom are covered up when the basket receives the first batch of work. Thus instead of coming in contact with the work, the cool incoming liquid is forced to pass around the basket and up the side of the cooling tank to the overflow.

To overcome these difficulties, the special basket in Fig. 1 was designed. This basket was used in a tank in which the cooling medium enters at the bottom from the source of supply at a pressure just sufficient to agitate the liquid at the top of the tank. The liquid then passes through tube *A*, out under the conical shaped head *B* to the top of the basket and over the edges of the tank to the overflow. When the parts are dumped into the basket they must pass through a column of liquid two feet deep which is maintained at a uniform temperature. The mass of parts breaks up on striking cone *B*, and continuing on its way downward meets the incoming liquid from under the cone while it is passing to the bottom of the basket where it comes to rest around the central tube. Uniform temperature conditions are thus maintained so that every part receives the same treatment.

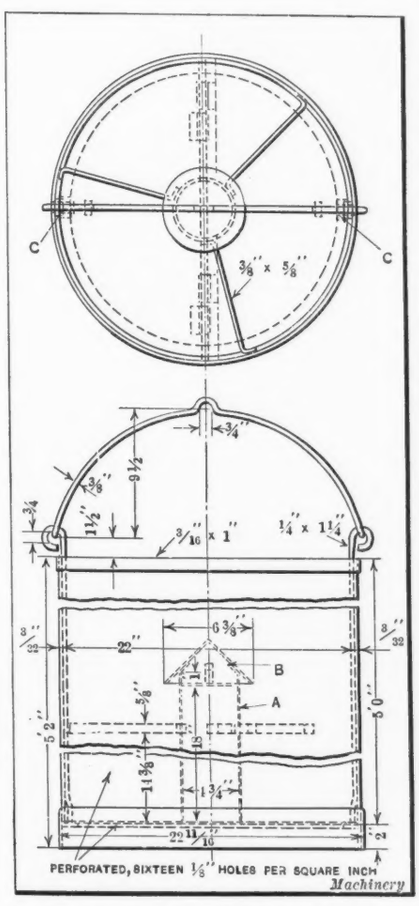


Fig. 1. Sheet-iron Basket for quenching Small Parts

As it would be difficult to remove the contents of this basket in the regular manner, the bottom was made in two halves hinged in the middle and held by latches *C*. The bottom halves swing down when the latches are released.

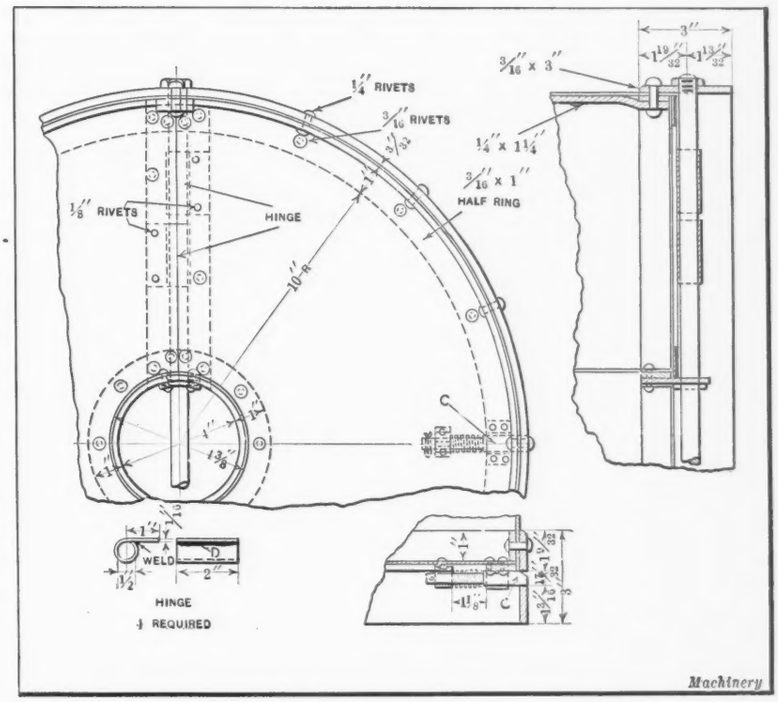


Fig. 2. Details of Hinged Bottom of Basket shown in Fig. 1

Fig. 2 shows the details of the hinges and latches *C*. The latches are made flush with the outside of the basket to prevent them from being accidentally disengaged or damaged by contact with the circulating coils of the tank. A rod placed against the end of the latch and given a light blow forces the latch from engagement with the slot in the side of the basket. This permits the bottom to swing downward so that the quenched parts will drop out.

The hinges for the bottom of the basket are attached by rivets. A detail of one of these hinges is shown in the lower left-hand corner of Fig. 2. The cylindrical part of the hinge is formed by rolling up one end of the flat stock and welding it at *D*. Baskets of this kind have proved very satisfactory and have been in constant use for the last five years.

* * *

CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA

A news item in July MACHINERY mentioned the formation of the Consolidated Machine Tool Corporation of America through a combination of the Newton Machine Tool Works, Inc., Philadelphia, Pa.; Hilles & Jones, Wilmington, Del.; Betts Machine Co., Rochester, N. Y.; Colburn Machine Tool Co., Cleveland, Ohio; and Modern Tool Co., Erie, Pa. To this list has been added the Dale Machinery Co., Inc., New York and Chicago; and the Ingle Machine Co., Rochester.

Officers of the corporation have also now been chosen. W. H. Marshall, formerly president of the American Locomotive Co., is chairman of the board of directors; C. K. Lassiter formerly vice-president of the American Locomotive Co. is president. The vice-presidents are H. J. Bailey, president of the Hilles & Jones Co.; H. W. Breckenridge, vice-president of the Colburn Machine Tool Co.; H. W. Champion, president of the Newton Machine Tool Works, Inc.; J. J. Dale, president of the Dale Machinery Co.; and A. H. Ingle, president of the Betts Machine Co. and the Ingle Machine Co. O. D. Miller is treasurer of the new corporation and R. R. Lassiter, secretary.

The board of directors includes, besides W. H. Marshall, chairman, C. K. Lassiter, H. J. Bailey, B. J. Baker, H. W. Breckenridge, Lawrence Chamberlain, H. W. Champion, J. J. Dale, T. Allen Hilles, A. H. Ingle, and F. D. Payne. The general offices are at 17 E. 42nd St., New York City.

STUDY MAKES MORE EFFICIENT MECHANICS

By JIM HENDERSON

No mechanic will ever attain a high state of proficiency if he neglects to acquire and retain those rudiments of arithmetic that are essential to a more thorough understanding of the fundamentals of mechanical engineering. Too many workmen of today are apparently content with the limited knowledge required to enable them to perform the actual operations of cutting metal to bring a piece of material to the specified shape and dimensions. Without the application of mathematics the study of engineering would be virtually impossible, and without a fair knowledge of the first principles of arithmetic, even the simplest mechanical operations would be difficult to perform. Many men fail to realize the importance of acquiring the technical or theoretical principles of mechanics as a means of simplifying the solution of their shop problems. The fact that a boy has been able to obtain only a limited public school education should not deter him from aspiring to a more thorough knowledge of the science upon which his work is based.

It is probably true that modern methods of manufacture often eliminate the necessity for the workman to use the learning of his younger days in the production of the work upon which he is engaged. This condition, however, must be accepted and must be recognized by every workman as one that will gradually place the machine tool operator in a position relatively the same as any part of the machine that he is called upon to serve. The actual thinking and planning of his duties is becoming a problem in the solution of which the workman has little to do, owing to the so-called "efficiency methods" that are constantly being adopted in mechanical industries. These systems, however, unless operated on a comprehensive cooperative basis, must eventually crush the individual initiative in factory employes, so that their tasks become more a subject of observation and application than the concentration of reasoning powers for successful achievement. It is obvious, therefore, that if a workman aspires to a higher position, where his brain will relieve his hands of the labors of former days, he must acquire the knowledge that will enable him to apply these potential but often dormant faculties.

Many young men, and not a few that are advanced in years, refrain from the study of technical journals or handbooks because of the general use of formulas in such textbooks, believing that a comprehensive knowledge of algebra is required before these formulas can be used. A brief study of a formula will demonstrate to the average mechanic that the only requirement is a well grounded learning in the elementary principles of arithmetic and a patient application of these fundamental rules. Of course, there are many formulas that necessitate a wider knowledge of mathematics than those possessed by ordinary mechanics, but persistent study and practice in working out the simpler problems will gradually develop the reasoning powers to such an extent that, eventually, the difficulties will not appear so formidable.

To achieve, one must continue to strive, as the prize is invariably given to the winner, and in these days of rapid progress and development no man can hope to succeed and at the same time be content to sit still and let the boat drift with the tide. Seldom does the current flow in the right direction, and in order to reach a haven where the "going" requires less effort, it is necessary to get out the oars and pull against the stream, and the harder you pull the sooner you will be in a position to watch the others as they drift indifferently or struggle to free themselves from undesirable though oftentimes unavoidable environment.

Many men today are wasting their time and energies in commenting on the other fellow's job—a factor that cannot but detract from the ability to do justice to their own. Those men who are continually envying the other fellow and his "soft job" will rarely ever find themselves in a similar position, as with few exceptions these so-called "soft jobs" are the result of previous concentration, study, and hard work. Therefore, it is imperative, and also quite obvious, that the ambitious young mechanic who hopes for greater remuneration or a more responsible position, must use every means to fit himself for the wider duties that call for a thorough knowledge of the work upon which he is temporarily engaged, together with the fuller technical understanding that is essential to the successful filling of the job higher up.

* * *

COOPERATION IN STANDARDIZATION

The Division of Simplified Practice has been established by Mr. Hoover in the Department of Commerce with a view to cooperating with manufacturers and engineering societies in engineering standardization work. The American Society of Mechanical Engineers and the American Engineering Standards Committee are among the engineering bodies cooperating with the Department of Commerce in this work. It is not the intention of the Division of Simplified Practice to duplicate the engineering standardization work now being done through the agency of the American Engineering Standards Committee, but to develop a special field of broad usefulness by reducing the number of sizes and by simplifying the varieties of manufactured articles in common use. Secretary Hoover has invited the cooperation of all engineering and trade societies for determining what simplification in manufactured products is most needed and most desired at this time. Members of engineering societies who have suggestions with regard to simplifying the varieties of manufactured articles in common use, or the standardization of sizes in general for manufactured articles, are requested to communicate with either the Division of Simplified Practice of the Department of Commerce, Washington, D. C., or the American Engineering Standards Committee, 29 W. 39th St., New York City.

* * *

STATISTICS OF THE MACHINE TOOL INDUSTRY

The accompanying tables have been prepared from statistics compiled by the Bureau of Census of the Department of Commerce. Table 1 shows the distribution of the machine tool industry in the different states in 1919, the percentages given being based on the value of the product of the machine tool shops in each state. It will be seen from this table that Ohio produces nearly 30 per cent of the machine tools in the country. The New England states together produce nearly 35 per cent, Massachusetts and Rhode Island leading, with Connecticut a close third. The three states, Ohio, Massachusetts, and Rhode Island produced in 1919 over one-half of the machine tools built in the country.

TABLE 1. DISTRIBUTION OF MACHINE TOOL INDUSTRY IN DIFFERENT STATES IN 1919, BASED ON THE VALUE OF THE PRODUCT

State	Per Cent	State	Per Cent
Ohio	29.5	Delaware	1.200
Massachusetts	11.0	Kentucky	0.500
Rhode Island	10.5	Minnesota	0.400
Connecticut	8.7	Maryland	0.300
Pennsylvania	7.9	Missouri	0.210
Illinois	7.1	New Hampshire	0.110
Michigan	6.0	California	0.036
Vermont	4 5	Washington	0.031
Wisconsin	4.4	Maine	0.008
New Jersey	3.2	Iowa	0.004
New York	2.4	Kansas	0.001
Indiana	2.0	United States	100.000

Machinery

TABLE 2. VALUE OF PLANTS AND PRODUCT OF THE MACHINE TOOL INDUSTRY IN 1919

State	Number of Plants	Value of Land, Buildings, and Equipment	Taxes Paid	Cost of Materials	Cost of Fuel and Power	Value of Product	Value Added by Manufacture
Ohio	102	$56,626,865	$6,294,723	$16,731,367	$745,468	$62,554,169	$45,077,334
Massachusetts	46	32,446,551	1,072,132	6,532,701	376,062	23,442,547	16,533,784
Rhode Island	13	25,036,802	1,723,094	3,368,170	325,796	22,301,290	18,607,324
Connecticut	33	20,380,557	1,040,390	4,548,245	374,721	18,435,449	13,512,483
Pennsylvania	32	21,869,376	1,967,759	4,516,253	251,782	16,797,040	12,029,005
Illinois	28	14,323,537	593,090	4,582,312	173,097	15,008,096	10,252,687
Michigan	31	14,438,803	619,855	3,789,355	182,818	12,656,492	8,684,319
Vermont	6	11,041,881	1,434,642	2,817,119	110,016	9,609,745	6,682,610
Wisconsin	24	10,865,674	1,044,683	2,456,188	142,270	9,414,820	6,816,362
New Jersey	14	7,343,687	936,220	2,345,341	75,241	6,767,671	4,347,089
New York	29	7,351,076	306,956	1,231,764	73,181	5,027,880	3,722,935
Indiana	15	4,315,557	206,788	1,303,228	71,107	4,259,463	2,885,128
All other states	30	4,999,477	598,570	1,826,291	84,415	6,125,496	4,214,790
United States	403	231,039,843	17,838,902	56,048,334	2,985,974	212,400,158	153,365,850

Machinery

Table 2 shows that the value of the land, buildings, and equipment of the plants engaged in machine tool manufacture in the United States was about $231,000,000, and that the total value of the product was $212,000,000. The machine tool industry in that year paid nearly $18,000,000 in taxes.

Table 3 shows that nearly $75,000,000 was paid in wages to office and shop employes, and $9,500,000 in salaries to officials. The total number of people engaged in the machine tool industry was nearly 62,000.

SAFETY CODE FOR FOUNDRIES

The American Engineering Standards Committee has approved a national safety code for the protection of industrial workers in foundries. This code is a revision of that developed by the American Foundrymen's Association and the National Founders' Association who are joint sponsors of the new code. The code has been worked out by a committee composed of four representatives of makers of foundry equipment and owners of foundries, four governmental bodies, two technical societies two insurance organizations, and a representative of foundry employes. Copies of the code may be obtained from the American Engineering Standards Committee, 29 W. 39th St., New York City.

The American Engineering Standards Committee has also approved a national electrical safety code as proposed by the Bureau of Standards, which covers the generation, distribution and utilization of electricity for power, light and communication. It constitutes one of the most important steps yet taken in safeguarding electrical installations.

TABLE 3. NUMBER OF EMPLOYES, SALARIES AND WAGES IN MACHINE TOOL INDUSTRY IN 1919

State	Number of Plants	Persons Engaged in the Industry					Salaries and Wages		
		Proprietors and Firm Members	Salaried Officers Superintendents, and Managers	Office Employes	Average Shop Employes	Total	Officials	Office Employes	Shop Employes
Ohio	102	29	663	1565	13,855	16,112	$2,511,242	$2,028,768	$17,071,620
Massachusetts	46	22	274	942	6,471	7,709	925,899	995,451	7,610,041
Rhode Island	13	2	142	463	7,169	7,776	536,253	661,396	8,702,410
Connecticut	33	2	208	629	5,472	6,311	926,324	669,478	7,247,888
Pennsylvania	32	17	163	549	3,671	4,400	717,680	936,704	5,141,121
Illinois	28	6	145	417	3,273	3,841	650,595	646,123	4,410,243
Michigan	31	5	137	347	3,196	3,685	663,481	547,780	4,408,088
Vermont	6	....	39	250	2,024	2,313	290,747	479,571	2,550,347
Wisconsin	24	6	158	244	2,352	2,760	711,431	499,472	2,836,033
New Jersey	14	4	113	391	1,678	2,186	349,188	586,792	1,519,552
New York	29	12	106	155	1,590	1,863	398,641	201,312	1,825,120
Indiana	15	6	114	116	1,228	1,464	478,508	136,472	1,383,825
All other states	30	21	71	118	1,132	1,342	331,963	156,585	1,472,681
United States	403	132	2333	6186	53,111	61,762	9,491,952	8,545,904	66,178,969

Machinery

Table 4 shows a comparison of the sizes of machine tool building plants in 1919. This table shows that 13 per cent of the number of plants (representing the largest shops) produced 69 per cent of the product, while 45 per cent of the plants (representing the smallest) produced only 3 per cent of the product. The total number of shops was 403.

This is the first time that statistics as complete as these have been compiled for the machine tool industry, and the Bureau of Census has performed a valuable service in preparing a complete record of the important facts relating to this basic industry.

TABLE 4. COMPARATIVE SIZES OF MACHINE TOOL BUILDING PLANTS IN 1919

Value of Lands, Buildings and Equipment	Number of Shops	Total Number of Shop Employes	Number of Employes per Shop	Value of Product	Product per Employe	Average Value of Product per Shop	Per Cent of Total Value of Product in Industry
Over $1,000,000	52	35,525	683	$146,142,000	$4100	$2,310,000	69
$500,000 to $1,000,000	41	7,235	176	27,856,000	3869	679,000	13
$100,000 to $500,000	134	8,162	62	31,760,000	3873	238,000	15
Less than $100,000	176	2,186	12	6,642,000	3030	38,000	3
Total of all shops	403	53,111	132	212,400,000	4000	531,000	100

Machinery

The Machine Tool Industry

THE improvement in the machine tool industry, although slight, is none the less definite. The average orders of seventy-nine firms in this field, during the month of June, amounted to 25 per cent of the shipments for the first three months in 1920—the period which had been taken as a standard for purposes of comparison. Seven of these firms reported a business of over 50 per cent; and eighteen, or about one-fourth of the number, of over thirty per cent. These comparisons are made on a dollars and cents basis. When the lower prices of machine tools at the present time are considered, it is evident that the actual volume of machines sold reaches higher percentages than those mentioned.

There is a great difference in the activity, however, according to the line of machines being built. Grinding machines are among the types in greater demand than most other lines. There has also been a good market for small automatic screw machines due to the activity in the radio field, but this demand is now falling off somewhat. Orders for special machines for high production are in evidence to a greater extent than orders for standard lines of machine tools; the automobile industry has been largely responsible for this. Service stations and garages have also been among the important customers of the machine tool industry. The automobile repair shop business has also afforded an outlet for a considerable part of the second-hand machine tools that have been on the market.

One of the encouraging signs is the brisk demand for grinding wheels, indicating that the metal-working industry as a whole is resuming its activity. Some grinding wheel plants state that the demand is much above the pre-war figure, and in one instance, at least, the plant is running at full capacity.

In the special machinery field business is fairly active, some shops in this class being occupied at approximately 60 per cent of their capacity. Most of the business in this field is domestic, but some orders are being booked from Japan, Australia, and South America. The trade with Europe is small, although recently some special machinery has been ordered from England.

Generally speaking, the conditions in the machine tool and accessories field are somewhat less active in New England than in the middle western states, due, no doubt, to the proximity of the latter to the automobile industry. In New England, second-hand machinery is still in greater demand than new machines, whereas a Cleveland dealer states that the tide has turned in that district and that new machines are sold in excess of used equipment. One of the main difficulties with which machine tool builders have to contend is the spotted condition of business, one month being quite good and giving a fair promise of continually increasing business, while during the following month business falls off, keeping the average for the year down. The greatest activity is naturally noted in the plants directly or indirectly supplying the automobile shops. Plants so engaged are frequently running to capacity, and a few are even farming out part of their work.

Prices of Machine Tools

Several machine tool manufacturers have announced increases in their prices, and it is expected that there will be a general advance in machine tool prices. The reductions that have been made during the past eighteen months are entirely too great to remain permanently in effect. Labor rates and material costs have not been sufficiently reduced to warrant the prices that have been quoted—prices that in many instances were quite far below replacement costs.

General Activities in the Machine Shop Field

The screw products shops are well occupied. A few months ago very low prices were quoted for screw products, but this condition is now improving. The sheet metal stamping shops in the Middle West are generally fully occupied; in New England, they are running at from 50 to 80 per cent.

Several machine tool builders who have embarked upon the manufacture of other lines of machinery in order to divert some of their shop capacity have been quite successful in their new ventures. Among the products that are thus turned out in machine tool plants are road-building machines, concrete block machines, domestic washing machines, auxiliary steam turbines, electric fans, and air conditioners. The interest in road-building throughout the country has created great activity among manufacturers of this line of machinery, and makers of excavating machines and steam shovels are fully occupied.

In the small tool field the conditions are gradually improving, even if not so rapidly as was at one time believed would be the case. Most of the manufacturers of small tools are working at from 30 to 40 per cent capacity. Practically the same condition exists in the measuring tools.

Conditions in the Gear-cutting Shops

Gear-cutting shops in the Pittsburg district operate at from 40 to 50 per cent capacity but competition makes it difficult to obtain a satisfactory price for the product. This refers to shops engaged in general gear-cutting, rolling mill gears, and mine gearing. The shops devoted to automobile gears are running to capacity, and some are said to have difficulty in meeting the demand for early deliveries. In the Cleveland district the shops employed in general job work run from about 40 to 70 per cent capacity. Gearing for heavy machinery is beginning to be ordered again, indicating increased business of heavy machinery builders.

The Automobile Industry

In the automobile field the past three months have shown an unusual activity. In May over 231,000 passenger cars and nearly 25,000 trucks were built. The figures for June were, in round numbers, 240,000 and 30,000 respectively; and while there was some decrease in the July production schedules of passenger cars, the drop was not more than 20 per cent, while the production of trucks increased.

The continued demand for automobiles has revealed an unexpected purchasing power on the part of the general public, and some makers have found it impossible to supply their dealers immediately with cars to meet the demand. Ford production naturally has led all the rest with considerably over 100,000 cars a month for several months. The total production of passenger cars for the first six months of the year is about 1,100,000, and of trucks, about 120,000. There are at present 177 manufacturers of passenger cars in the United States and 230 manufacturers of motor trucks.

The Studebaker plants have been working to capacity for some time past. Plans for a considerable increase in machining equipment and output are under way. It is said that when the plans now laid have been consumated, the Studebaker South Bend plant will be capable of producing 500 cars a day. This will, of course, require a large amount of machine tools, some of which are now being bought.

New Machinery and Tools

The Complete Monthly Record of New American Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

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Reed Inside Micrometer with Height-gage Attachments. Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. 1014
Watson Multi-speed Alternating-current Motor. Mechanical Appliance Co., Milwaukee, Wis. 1015
Leinert Rapid Calculator. W. Leinert, 410 W. 23rd St., New York City 1015
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Liberty Combination Planer and Slotter

PLANING and slotting operations on locomotive frames are usually cumbersome jobs because of the size of the work and the necessity of setting up the work on both a planer and a slotter or shaper for the performance of the operations. The time consumed in making one of these set-ups is eliminated with the combination planer and slotter presented in the accompanying illustration. This machine has recently been developed by the Liberty Machine Tool Co., Hamilton, Ohio. Another advantage of this machine is the saving of floor space, this being an important factor owing to the size of the machines necessary for handling work of this class. The machine has two cross-rails near the middle of the bed; one supports a planer head and the other carries a slotter head. The cross-rail for the slotter head can be swiveled entirely out of the way when the machine is being used for planing work that requires the raising of the planer cross-rail to its highest position. The machine has a duplex control by means of which the different moving parts may be operated from either side of the bed. The planer and slotter units are individually motor-driven. Although the machine was designed primarily for finishing locomotive frames, it is adaptable to other jobs.

Construction of the Planer Unit

The parts embodied in the planer unit are identical to similar parts included in the standard 36-inch planer built by

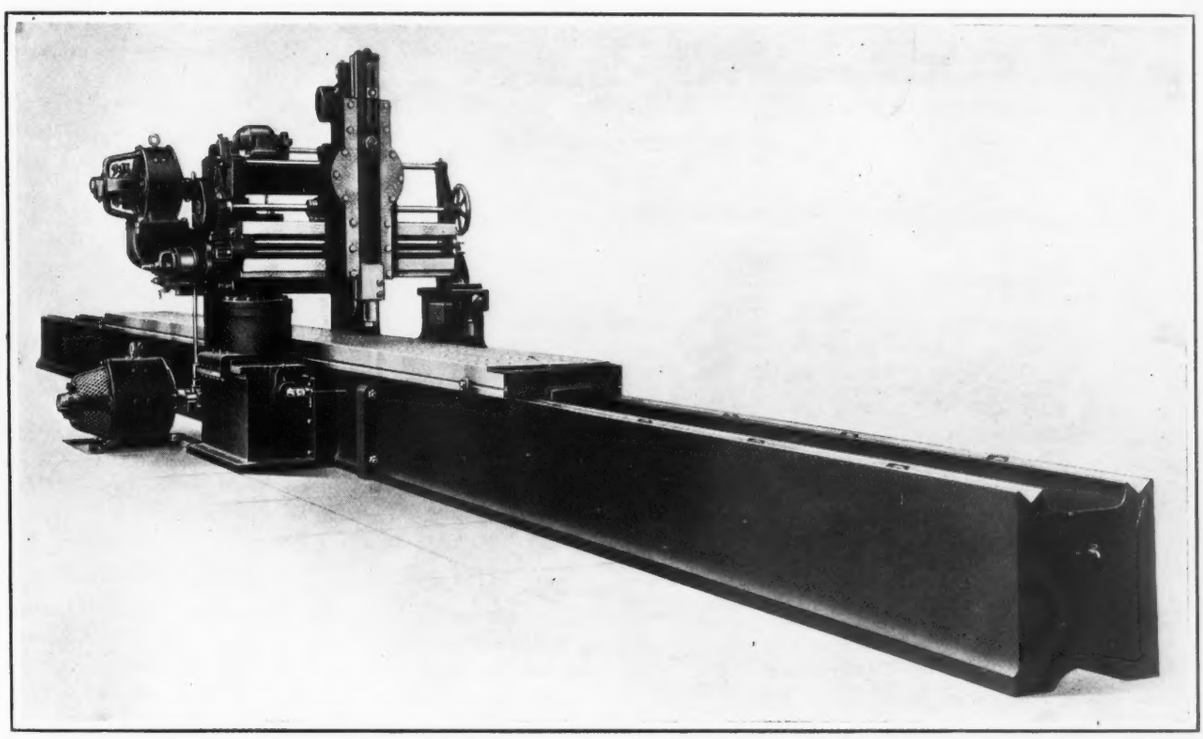


Fig. 1. Liberty Combination Planer and Slotter developed to reduce the Machining Time of Locomotive Frames

the same company. This unit is arranged with a reversing motor-drive, which gives the necessary range of speeds. Although only one head is shown on the cross-rail, two may be furnished on this member, and side-heads may also be provided on the housing faces. The bed is of box construction and has a closed top between the vees. The latter are fitted with automatic oiling rollers to insure proper lubrication of the bearing surfaces.

The rollers may be readily removed to facilitate the cleaning of pockets. The table T-slots are planed for the solid, and the holes provided for clamping work on the table are reamed. The cross-rail is of sufficient length to allow two heads to have a full traverse across the table. The cross-rail elevating screws are supported on ball bearings and are adjustable from the top.

The heads are made right- and left-hand for close range, and may be swiveled to any position up to 90 degrees, graduations indicating the angularity of a setting. The heads have automatic feeds in all directions, which are operative from either end of the cross-rail. Micrometer adjustments are provided on all vertical and horizontal feed-screws. The cross-rail elevating mechanism is located on the top brace and is controlled by means of a long handle at the side of the housing. This handle is employed to engage or disengage a saw-tooth clutch when raising or lowering the cross-rail. The handle must be held in order to keep the mechanism in operation and, therefore, any obstruction interfering with a movement of the cross-rail will cause the clutch to be instantly disengaged, thereby avoiding any breakage of parts.

When side-heads are attached to the housings, they can be moved to a position below the top of the table when not in use. Patented feed micrometer collars and control handles are conveniently located on these heads and they may also be swiveled through an arc of 90 degrees. This planer has a patented feeding arrangement by means of which the operator can control or change the rate of feed of the cross-rail heads without stopping the machine or disturbing the feeds of either side-head. Similarly, he can change the rate of feed of the side-heads without disturbing the rate of feed of the cross-rail heads. Feeding movements may take place either on the cutting or on the return stroke. All feeds may be disengaged by placing a handle in a neutral position.

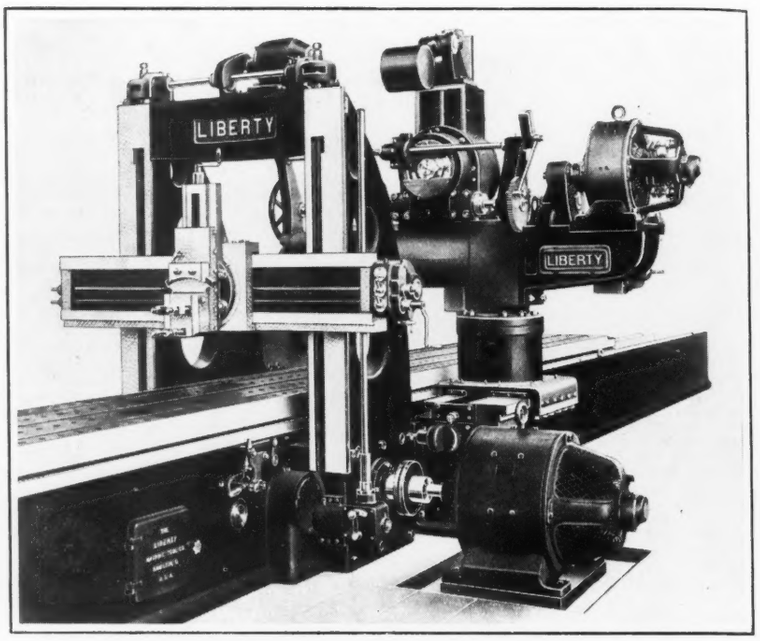


Fig. 2. Close-up View showing Front of Planer Unit and Back of Slotter Unit

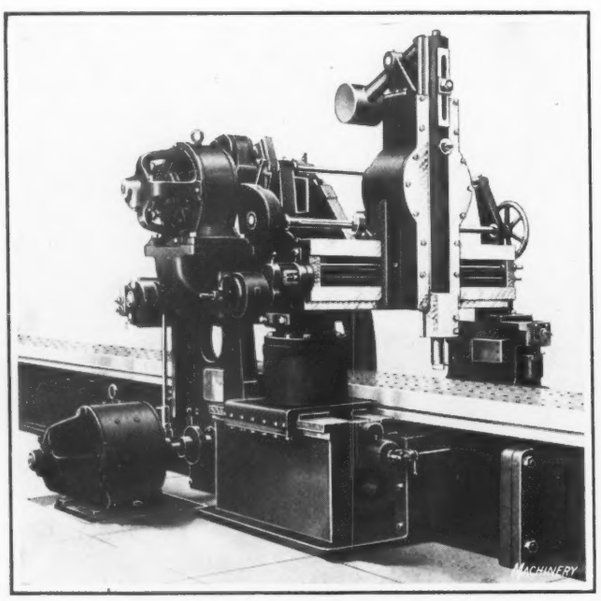


Fig. 3. Illustration in which the Details of the Slotter Unit may be clearly seen

The Slotter Features

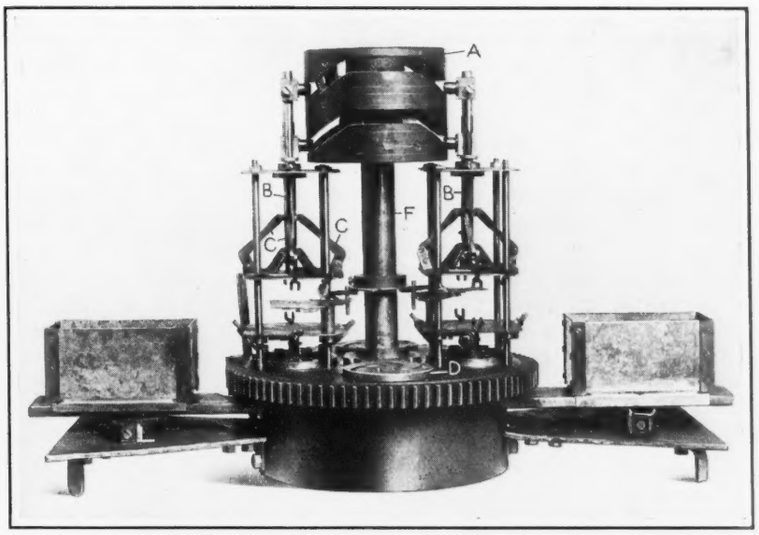
The slotter unit is driven by a variable-speed motor which gives the necessary range of speeds to the ram. Two additional small motors provide power for quickly moving the cross-rail and the ram head. This unit has a 24-inch travel lengthwise relative to the machine, for which movement there is an automatic feed and rapid traverse in both directions. One end of the cross-rail is mounted on a column upon which it may be swiveled, by the rotation of a screw, either forward or backward along the bed to any angle within the limits of locomotive frame work. Clamps provide for holding the cross-rail securely in any angular setting. As previously mentioned, the cross-rail can also be swiveled entirely out of the way to permit the use of the planer unit for machining high work.

The ram head has an independent automatic feed and a rapid traverse in both directions. The ram is driven by worm gearing through a crank disk and connecting-rod, and is properly counterbalanced. The stroke is adjustable for both position and length. A special tool-bar is provided for circular feeding and for machining fillets. The table of the machine is held stationary when using the slotter unit, and is rapidly advanced to the next position after a cut has been completed, by the operation of a pendant switch.

Some of the principal dimensions of the machine are as follows: Maximum width between planer housings, 37 inches; maximum height under planer cross-rail, 37 inches; length of table, 38 feet; width of table, 30 inches; length of bed, 69 feet; miximum stroke of slotter ram, 14 inches; and maximum travel of slotter cross-rail, 24 inches. The weight of the machine is approximately 69,000 pounds.

W-J AUTOMATIC DIE-CASTING MACHINE

An automatic die-casting machine of a continuous rotary type which has been developed by the W-J Die Casting Machine Co., 1120 Marshall Field Annex, Chicago, Ill., to effect increased production rates in the manufacture of die-castings, is here illustrated. This machine consists of a rotating table on which are mounted four sets of cages which carry dies of any required form. Diametrically opposed to each



W-J Automatic Die-casting Machine developed to permit High Rates of Production

other are two melting pots from which a charge of molten metal is delivered to each die as it passes either pot. It will thus be apparent that two castings are produced in each of the four dies during each revolution of the table, or, in other words, eight castings per table revolution. The machine can be driven at the rate of two revolutions per minute, and at this speed, a production of 960 castings per hour will be obtained. At the time the photograph was taken, the melting pots were not in place in their cases on the slides which extend from the machine base, the die-carrying cages and their auxiliary mechanisms had been removed from two of the table stations, and the dies were not in place on the cages shown.

As each station of the table approaches one of the melting pots, the die members at that station are automatically closed and the melting pot advanced to them. A nozzle on the pot enters a socket on the die, after which the necessary amount of metal to fill the die is forced into it either by compressed air or by the action of a plunger. The melting pot then recedes, the die opens, and such core-pins as may be required, withdraw. A knock-out pin next pushes the casting from the upper die member, so that it falls on a tray that is automatically brought into position beneath it. As the table continues its rotation, a pair of revolving brushes passes between the die members and loosens any particles of dirt adhering to them. Finally, a jet of compressed air is blown on the die members to remove any foreign matter that may still remain on their faces. By this time the die cage approaches the second melting pot, and the cycle of movements which occurs is similar to that outlined.

As previously mentioned, each set of dies consists of two members, the upper one of which is movable and the lower stationary. The closing of the upper members on the lower ones preparatory to casting a part is accomplished through cam *A* which has two grooves around its periphery. Rollers which run in the upper grooves are secured to rods attached to the upper dies, and as a die set approaches either of the two melting pots its roller runs down a decline in the groove and causes the upper die to be pushed down upon the lower one. Simultaneously, the roller in the lower groove runs down a decline somewhat longer than that on the upper groove. This roller is secured to a sleeve *B* which in turn is connected to a link mechanism that provides for pushing core-pins into the four sides of the upper die. If vertical core-pins are required, they are pushed straight down through the die. The amount that each core-pin is advanced into the die may be adjusted.

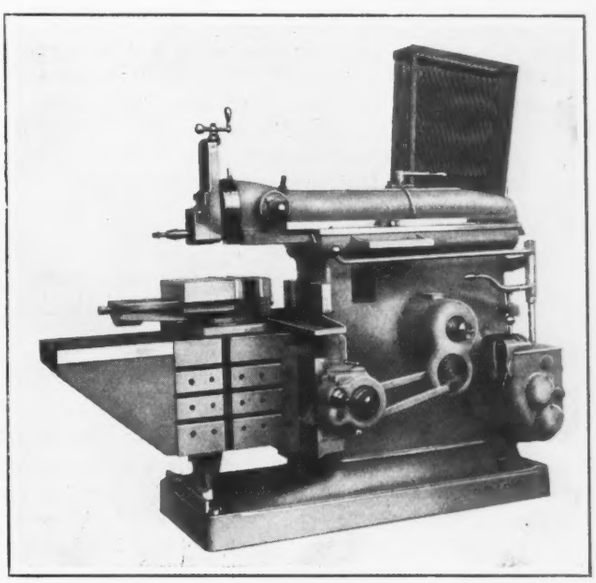
Provision is also made for introducing core-pins into the lower die member. Mounted at each of the four table stations is a plate cam *D* in which four spiral grooves are machined. Each of the cams is carried on a stem that projects through the table and carries a lever. As the table rotates, this lever strikes a dog which causes rotation of the cam. The pins which run in the cam grooves have their lower ends guided by straight grooves, and as each pair of pins slides in its groove, a link is rocked to push a core-pin into the lower die. There are four sets of rocking links to provide for introducing a core-pin into the four sides of this die.

After either melting pot has been advanced to a die, it rotates with it a sufficient length of time, after the nozzle of the pot has been properly inserted, to allow enough metal to be forced into the die. Thus it will be evident that the mechanism which actuates the melting pots must furnish a combined rotary and in-and-out movement.

For shops handling a moderate volume of work, a machine can be built with one melting pot and two sets of dies, or the machine illustrated can be provided with only one melting pot and two sets of dies. An important feature of this machine is that different castings may be produced at the same time by having suitable dies in the cages. Water is circulated continuously through the dies to keep them at the proper temperature. Gas jets heat the metal in the pots and maintain it at the desired temperature. Other gas flames preheat the compressed air which forces the molten metal into the dies. When a plunger and a cylinder are used for this purpose, these parts are also heated by gas flames to prevent solidifying the metal in the cylinder.

HENDEY CRANK SHAPER

A crank shaper equipped with a speed gear-box to permit a single-pulley or constant-speed motor drive has been recently introduced on the market by the Hendey Machine Co., Torrington, Conn. Except for the gear-box this machine is of the same general design as the cone-pulley shaper previously described in MACHINERY. Eight strokes ranging in geometrical progression from 6 to 102 per minute are obtainable, four of these speeds being secured through the gear-box,

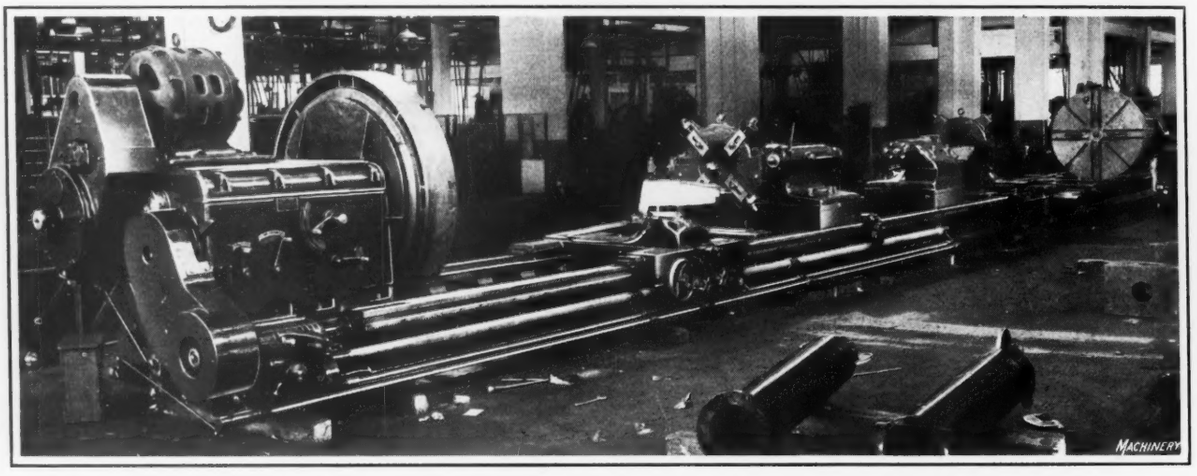


Hendey 24-inch Crank Shaper equipped with a Speed Gear-box

and four by means of back-gears. The speed box gears run in oil, and the driving and gear shafts in ball bearings. The gears of the gear-box are shifted by the manipulation of a ball handle lever about H-slots in the gear-box cover. The speed gears are made of alloy steel and are heat-treated. The length of ram stroke may be varied from 2 to 24 inches.

The driving pulley transmits power to the machine through a patented clutch which also serves as a brake when moved in the opposite direction to that in which it is shifted for driving. This clutch is controlled by the long horizontal lever which extends to the front of the machine on the right-hand side. The lever has a short movement which provides a quick starting and stopping feature to the ram that is especially of value in setting tools and taking measurements. The lever control also simplifies the meshing of the back-gears and the manipulation of the gear-box lever.

All adjustments of the patented cross-feed mechanism are obtained at the end of the cross-rail. The amount of feed can be varied while the machine is in motion, a dial indicator showing the amount of feed. The feed can be started, stopped, or reversed while the machine is in operation. The feeding movement takes place on the reverse stroke of the machine. The cross-feed screw is provided with a dial graduated in thousandths of an inch. The machine may be furnished with or without a power down-feed by means of which the machine may be fed at any rate from 0.005 to 0.060 inch per stroke, in increments of 0.005 inch. The machine is set for the different rates of feed by means of a graduated dial. Some of the important specifications of the machine are as follows: Horizontal table travel, 30 inches; vertical table travel, 14¾ inches; minimum distance from ram to table, 4 inches; dimensions of table top, 17 by 24 inches or 17 by 42 inches when equipped with an extension as illustrated; dimensions of table side, 17½ by 18 inches; and approximate weight of machine, 5700 pounds.



Betts-Bridgeford Double-head Engine Lathe which may be operated as One Long Machine with a Carriage and Tailstock removed, or as Two Individual Machines with these Members in Place

BETTS-BRIDGEFORD DOUBLE-HEAD ENGINE LATHE

In shops where large machines are installed for handling heavy work, such equipment frequently remains idle a great part of the time, owing to the unsuitability of the machine for handling smaller work. In bringing out the double-head engine lathe here illustrated, the Betts Machine Co., 400 Blossom Road, Rochester, N. Y., has provided the machine with two heads, two carriages and two tailstocks, so that when the entire length of the machine is not required for a job, the two ends may be operated as individual machines. This lathe has a lead-screw on each side of the bed; one lead-screw extends the entire length of the machine and the other is one-half that length. From this it will be obvious that the two carriages are fed from opposite sides of the bed. This lathe was primarily designed for turning heavy crankshafts and long propeller shafts. It has a swing of 72 inches and a bed length of 76 feet.

When the lathe is required for long work, one of the tailstocks is removed from the bed and the other is traversed to a position close to the headstock opposite the one with which this tailstock is employed. By doing this, the maximum distance between centers may be utilized. When the machine is required for shorter work which can be accommodated in somewhat less than one-half the maximum distance between centers, the second tailstock is replaced on the bed end to end with the first after the latter has been traversed approximately to the middle of the bed. In this way the machine is quickly converted into two entirely independent lathes each having a swing of 72 inches and a maximum distance between centers of 27 feet. As the machine is readily convertible from a long lathe into two shorter lathes or vice versa, it will be seen that economies of floor space may be effected.

The headstocks are alike in construction, being triple back-geared and provided with bronze bearings throughout. These bearings are chain-oiled from individual reservoirs. Twelve spindle speeds in geometrical progression are controlled by levers conveniently located at the front of the headstocks. These speeds are obtained through sliding hardened steel gears. A friction clutch and brake is incorporated in the driving mechanism of each headstock and operated from its respective carriage thus allowing the machine to be started or stopped instantly. In addition to the lever on the carriage, a secondary lever on the headstock supplies a means of operating this clutch and brake. A power rapid traverse is provided for both carriages and this is controlled by levers on the aprons. The aprons are of a double-wall construction and the gears are of steel. The machine is driven by two 50-horsepower motors mounted on the headstocks and controlled by automatic starters.

PRATT & WHITNEY ODONTOMETERS

An instrument known as the "Odontometer," manufactured by the Pratt & Whitney Co., Hartford, Conn., for testing the accuracy or uniformity of gear tooth profiles and spacings of the teeth in production work, was described in MACHINERY for July, 1921. This company has now announced a number of improvements in the design of the instrument, and are placing on the market two additional odontometers for testing larger and smaller gears. The original instrument was for use with gears from 3 to 10 diametral pitch, whereas the instrument shown in Fig. 1

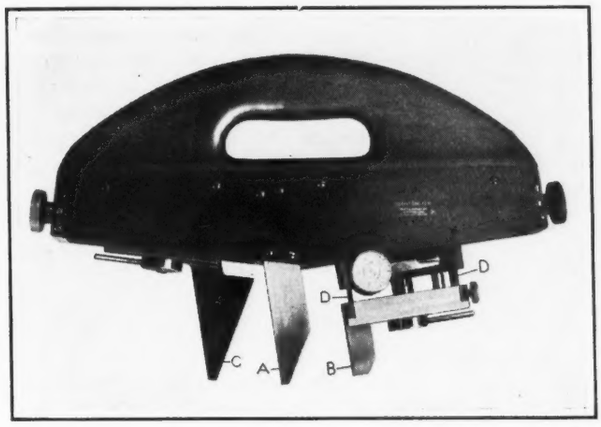


Fig. 1. Pratt & Whitney Odontometer for testing Spur and Helical Gears from ¾ to 4 Diametral Pitch

covers a range of from ¾ to 4 diametral pitch and that in Fig. 2 from 10 to 24 diametral pitch. The latter odontometer and that illustrated in the previous article may both be provided with stands to facilitate the testing of gears or pinion-shaped cutters. When either instrument is thus mounted, the gear is placed on the surface plate on the post of the stand and is rolled past the instrument. The actual cutting edge of cutters is tested so that errors of any nature are detected.

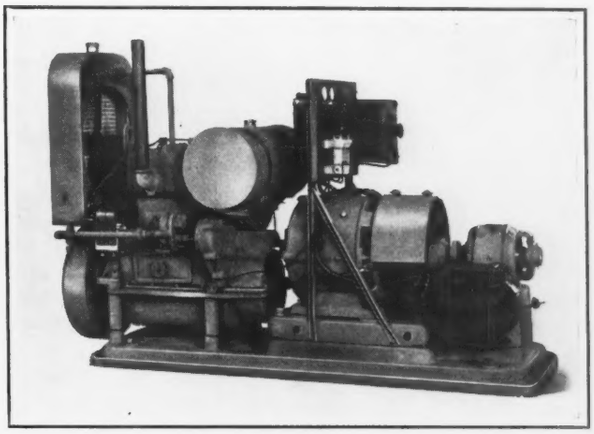
The principle upon which the new odontometers are based, is the same as that of the instrument previously described. In effect an odontometer is composed of a section of a straight-sided rack having two parallel effective faces, one fixed and the other movable. A third face, set at an angle to the two working faces, is used to hold the fixed working face in contact with the flank of the gear tooth. The fixed registering surface is at *A*, Fig. 1, and the movable indicating surface at *B*. The third surface *C* holds surface *A* in contact with the involute profile of the gear tooth. Surfaces *B* and *C* are adjustable so that gears of various pitches can be tested with the same instrument. The indicating surface *B* is mounted on two thin flat springs *D*, which act as pivots, free from backlash. The dial indicator is actuated by a lever having a ratio of 5 to 1, each division of the dial representing a movement of 0.0002 inch of surface *B*. The instrument is used to test the uniformity of mating gears.



Fig. 2. Odontometer for Gears from 10 to 24 Diametral Pitch

WESTINGHOUSE GASOLINE-DRIVEN WELDING EQUIPMENT

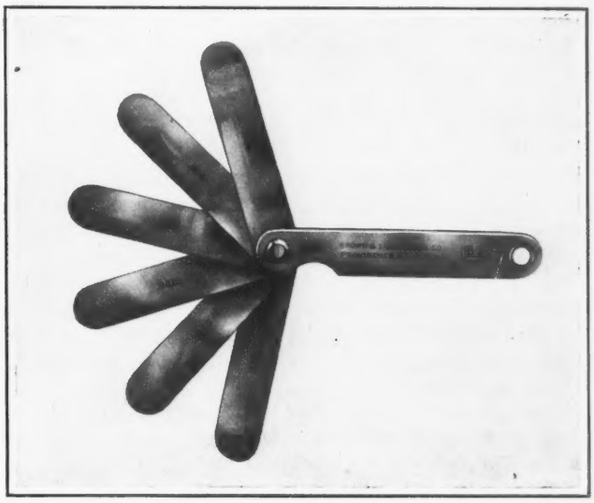
A welding equipment developed for use where electric power is not available for driving a motor has been placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. This equipment is made in both stationary and portable models. It consists essentially of a Westinghouse single-operator direct-current welding generator geared to a Doman 4-cycle, 2-cylinder, low-speed, marine-type gasoline engine. The generator has a rated capacity of 175 amperes and a maximum capacity of 225 amperes, at 1750 revolutions per minute. It is designed to operate at arc voltage and to inherently stabilize the arc and supply a substantially constant current of different values over the working range of 90 to 225 amperes. It is said to be easy for the operator to strike and maintain the arc and to obtain the deep penetration and thorough fusion necessary for satisfactory welding. The shaft of the generator is attached to the exciter by means of a flexible coupling. The control panel is mounted directly over the generator.



Westinghouse Welding Apparatus driven by a Gasoline Engine

BROWN & SHARPE THICKNESS GAGE

A thickness gage having six blades 0.0015, 0.002, 0.003, 0.004, 0.006, and 0.015 inch in thickness, respectively, which may be used individually or together for measurements up to 0.0315 inch, has been added to the line of mechanics' tools made by the Brown & Sharpe Mfg. Co., Providence, R. I. It is shown in the accompanying illustration. The blades are

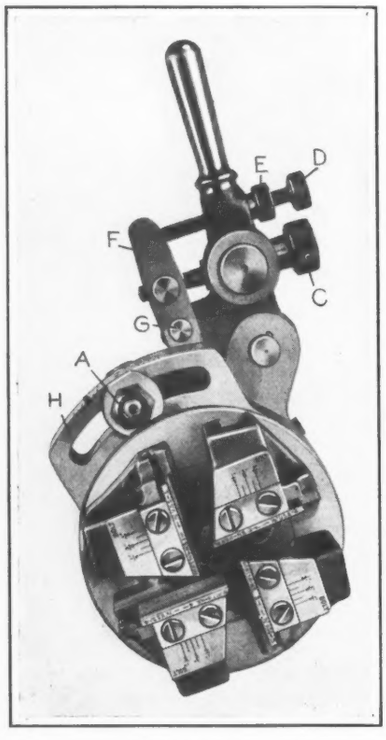


Brown & Sharpe No. 646 Thickness Gage

accurately ground to the specified thickness. The protecting blade has an eyelet that provides for hanging the gage on a carrying ring or on a hook. This gage will be found of value by automobile mechanics and owners for setting valve tappets, distributor points and spark plug gaps, fitting pistons, and making shims for eliminating rattle.

LANDIS STATIONARY DIE-HEAD

A stationary die-head equipped with a micrometer attachment which is particularly valuable when cutting threads of special form requiring one or more roughing cuts and a finishing cut, is a recent product of the Landis Machine Co., Inc., Waynesboro, Pa. It is possible to set this die-head so that the same amount of metal is left at all times for removal in the finishing cut. The head is graduated to suit both right- and left-hand threading of bolts and pipe. These graduations are placed on the closing ring above the circular slot. To adjust the die-head for cutting threads of a given size, the clamping nut *A* in the accompanying illustration is first loosened with the left hand, and then the closing ring is swiveled by the right hand to the proper graduation. Closer adjustment can then be made by means of the micrometer attachment. This is accomplished by first loosening lock-nut *E*, and then turning the micrometer screw *C*. This screw is turned in the counter-clockwise direction to increase the diameter to which the chasers are set, the turning of the screw causing the upper part of link *F* to swing toward the left about center *G*. This action pulls the closing ring *H* toward the right. If the micrometer screw *C* is turned in the clockwise direction, the movement of link *F* toward the right results in a decrease in the diameter of the chaser setting. After making the micrometer adjustment the stop-screw *D* should be set against the link *F* and locked in place by means of the lock-nut *E*.



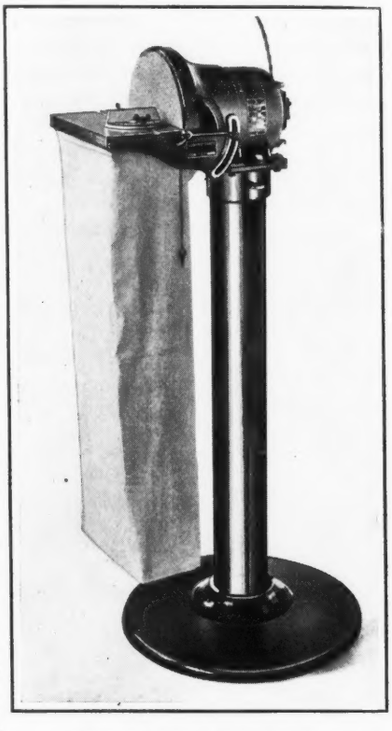
Landis Stationary Die-head with Micrometer Adjustment

To adjust the chasers for taking a roughing cut, the micrometer screw *C* is turned in the counter-clockwise direction until the desired setting has been obtained, the stop screw *D* being left in its originally located position. A number of roughing cuts can then be made by adjusting the die-head after each cut, again turning screw *C* to effect this adjustment. After the roughing cuts have been completed, the micrometer screw should be revolved until link *F* comes against the stop-screw *D*. The die-head is then set for taking the finishing cut.

This die-head can be applied to turret and engine lathes, hand screw machines, and other types of threading machines in which the work revolves and the threading head remains stationary. For application to a turret lathe, the die-head is equipped with a shank that fits the sockets of the turret. Application to the cross-slide of the engine lathe is made by means of a special knee bracket having a boss machined to fit a counterbored hole in the back of the die-head. It is necessary to provide a special dead center that will fit bores in both the bracket and the die-head. Work may also be gripped in a chuck and threaded without the use of centers when the shape of the part necessitates this form of support.

SYRACUSE PORTABLE MOTOR-DRIVEN DISK SANDER

A 9-inch motor-driven disk sander mounted on a pedestal as illustrated in order to provide an equipment readily portable about the shop has been brought out by the Syracuse Sander Mfg. Co., Inc., 1232-1234 S. State St., Syracuse, N. Y. The sander is driven by a 1/6-horsepower enclosed motor having an attached switch. Current may be received from a lamp socket. The sander can be swiveled on top of the pedestal so as to bring the disk toward the light. The table tilts 45 degrees below horizontal and 15 degrees above it, a graduated plate indicating the angularity of a setting. The table is secured in a set position by tightening a thumbscrew. An angle gage graduated in degrees is furnished. The disk is covered with emery cloth on one side for sanding metal parts and with garnet paper on the opposite side for wood work. Dust from the work is sucked into the canvas bag attached to the under side of the table. The operator is thus relieved of all the annoyance occasioned by flying dust. This sander is also supplied without a pedestal for mounting on benches.



Syracuse 9-inch Disk Sander

ROCKFORD NO. 3 HIGH-POWER MILLING MACHINE

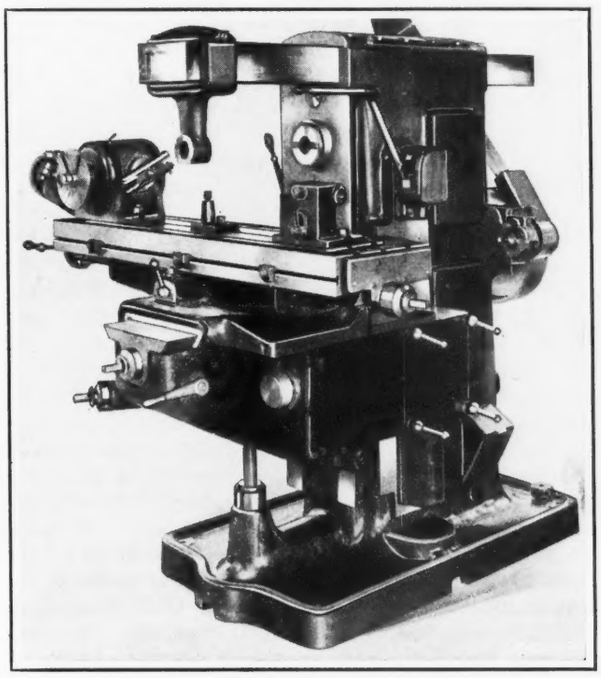
The Rockford Milling Machine Co., Rockford, Ill., has brought out a No. 3 high-power milling machine of the single-pulley type which differs in certain respects from the No. 3 machine previously described in the technical press. The use of driving shafts is entirely eliminated for conveying power to the knee. The transmission is all enclosed in the knee casting which projects on the right-hand side of the column and has an unusually wide bearing surface. A long gear is located in a vertical position in that part of the transmission housing which extends over the bearing face just referred to. Throughout the range of the movement of the knee, the long gear is always in mesh with the feed reverse and quick-return gears, which are located inside of the column directly behind the plane of the bearing face. This long gear also connects through a pair of bevel gears with a second long gear, located horizontally

at the side of the knee and meshing with the gears operating the knee saddle and table. It will be seen, therefore, that the entire feed drive is through gears which are always in mesh, and that there are no connecting shafts.

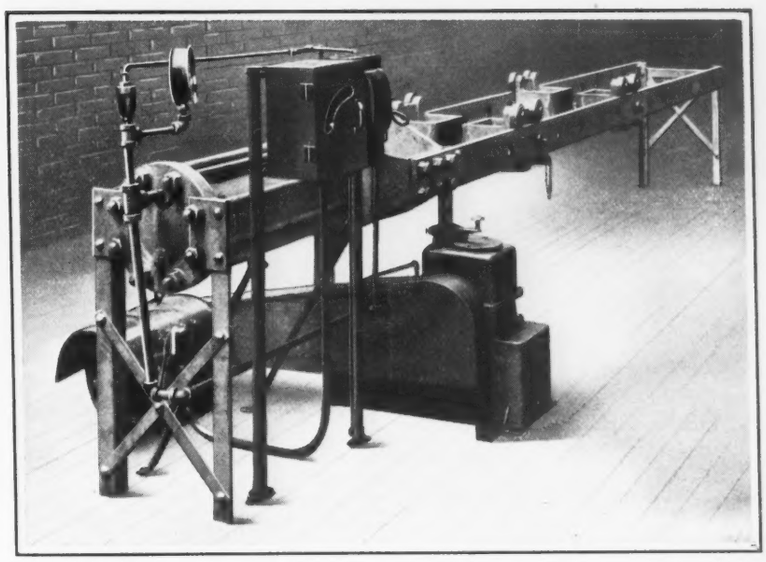
A feed-controlling lever, which determines whether the transverse or vertical feed is engaged, is located on the left-hand side of the knee within easy reach of the operator. This lever is provided with a dial on which are plainly marked the transverse and vertical positions of engagement as well as the neutral position, in which neither feed is engaged. The vertical and transverse feeds can also be controlled by a lever on the left-hand side of the knee near the column and within convenient reach of the operator when standing back of the table for such operations as boring. The shaft connecting this lever with the feed-control box extends through the back flange of the knee and projects to a point where it reaches the dogs of the automatic stop mechanism. On the side of the column there is a long vertical boss on which dogs may be adjusted to contact with the feed-bar and disengage the vertical feed at any predetermined point. This boss also has permanent safety stops for disengaging the feed within safety limits.

This machine, like the former design, has the rectangular over-arm and a column of the conventional box form enclosing practically the entire working mechanism. The splash system of lubrication is employed, each individual unit comprising an oil chamber where all gears run constantly in an oil bath. Either belt or motor drive can be supplied, a single constant-speed pulley mounted on Hyatt roller bearings being used for belt-driven machines. When a motor is used, it is mounted on a heavy pedestal bolted to the rear of the column and base, and it drives through a high-speed silent link chain provided with safety guards.

The machine table has automatic longitudinal and cross-feeds of 34 and 12 inches respectively, and there is an automatic vertical feed of 20 inches. Sixteen speed changes are provided ranging from 12 to 350 R. P. M. and 12 feed changes ranging from ½ inch to 16 inches per minute.



Rockford No. 3 High-power Milling Machine



Oilgear 25-ton Horizontal Press on which the Speed of Ram Travel may be changed instantly

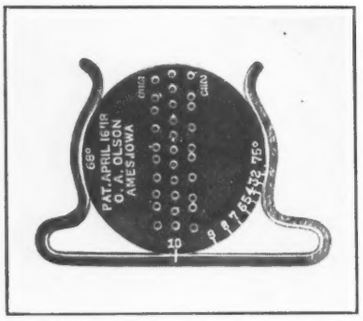
OILGEAR HORIZONTAL PRESS

A horizontal hydraulic press equipped with an "oilgear" control by means of which a wide range of ram speeds is made possible, has just been brought out by the Oilgear Co., 60-64 Twenty-seventh St., Milwaukee, Wis. The machine has a capacity of twenty-five tons at pressing speeds of from ¼ to 6 inches per minute. The maximum speed of the ram while traveling to the work is 37 inches per minute, and the maximum return speed, 56 inches per minute. The speed of ram traverse may be changed instantly by operating a small control lever conveniently located on top of the pump housing at the front of the machine. It is said that the ram stroke begins without shock and is made without pulsation. Suitable overload relief valves permit the ram to be driven at full speed against a stop without danger of injuries resulting to the machine parts or the work.

The pump is driven by a constant-speed two-horsepower motor located at the rear of the head end of the machine, as illustrated. The stops are of a V-shape and can be located along the machine frame as desired, being held in place by steel pins. The center of the ram is located 32 inches above the floor, and the distance between stop supports is 24 inches. The maximum stroke of the ram is 30 inches. At full capacity, a pressure of 800 pounds per square inch is exerted on the piston head, the cylinder being 9 inches in diameter. All working parts are lubricated automatically and no adjustments are necessary to keep the press in operating condition. This machine has been used for such work as assembling wheels on axles of saw-mill carriages and heads into pipe rollers. It is adaptable to many other jobs.

"AMES" LETTERING INSTRUMENT

For reducing the time consumed in placing guide lines on drawings when lettering titles and notes, the O. A. Olson Mfg. Co., 706 Wilson Ave., Ames, Iowa, has placed on the market the instrument shown in the illustration. This device consists of a nickel-plated tempered steel frame which retains a transparent celluloid disk that may be swiveled in the frame. The disk has three parallel rows of taper holes which furnish a means for quickly drawing guide lines without the necessity of first locating them by means of a scale. In laying out the guide lines, the instrument is placed with the base in contact with a T-square or straight edge, and then pulled alternately to the right and to the left by means of a pencil placed in the holes of the disk, the pencil being, of course, shifted from one hole to the next after each movement to and fro. The vertical height between the



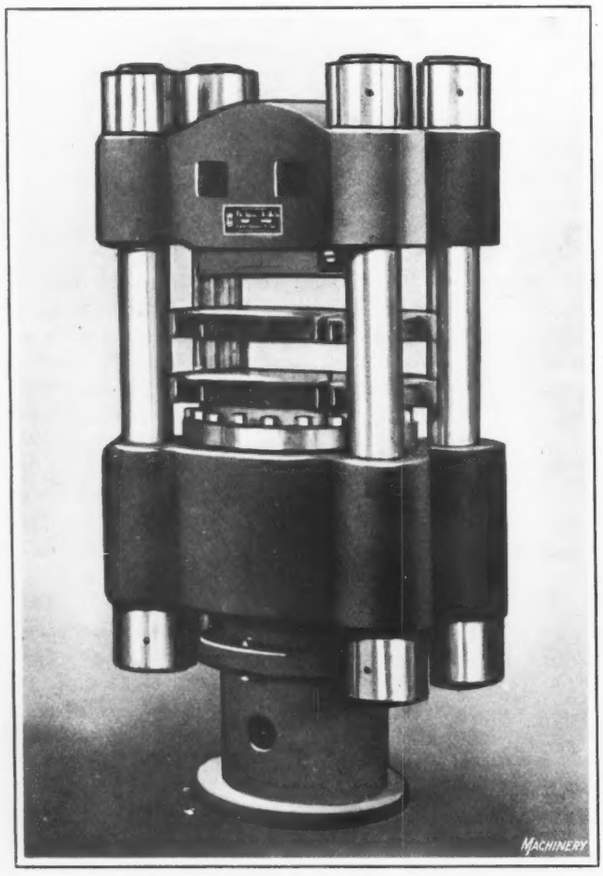
"Ames" Lettering Instrument

guide lines may be regulated by swiveling the disk in the frame. As the middle row is equally spaced, cross-section lines can be drawn uniformly. Slanting lines for letters may be quickly drawn after placing the instrument with an open and a closed end in contact with the straightedge.

HYDRAULIC PLASTIC MOLDING PRESSES

A line of hot- and cold-plate presses designed for producing small electrical insulating parts from bakelite, condensite and other non-conducting compositions, is now being built by the Hydraulic Press Mfg. Co., 84-88 Lincoln Ave., Mount Gilead, Ohio. Many of the parts which the presses are capable of producing are used in the construction of radio apparatus. There are three styles of presses: A double-opening, square-platen press which is intended for removable dies, and on which the upper plates are used for heating the material being molded, and the lower ones for cooling it; a single-opening square-platen press also intended for use with removable dies and in batteries of three, two machines of which are provided with hot plates, and the third with cold plates; and a single-opening rectangular-platen press for fixed dies, which is arranged for alternately heating and chilling the same plates.

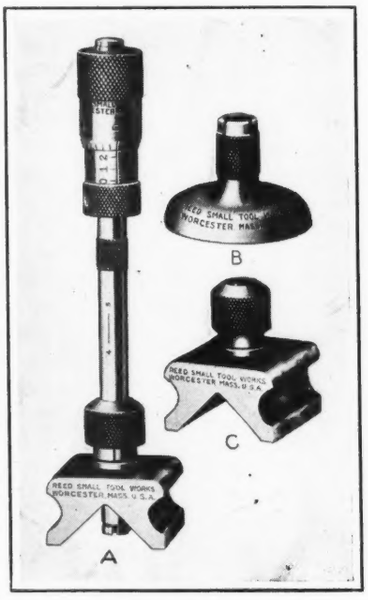
In the molding operation, the material is first heated to make it plastic and then pressure is applied to cause the material to conform to the die. For this part of the process, the hot plates are heated either by the circulation of steam, by gas flames, or by electrical resistance units. In the second part of the operation, the material is cooled while still in the die and under pressure. This is accomplished by chilling the plates by the circulation of water. Some materials may not require the procedure outlined. The pressure is applied in the upward direction. Each machine is equipped with four strain rods.



Hydraulic Plastic Press for molding Electrical Insulating Parts from Bakelite, Condensite, Etc.

REED INSIDE MICROMETER WITH HEIGHT-GAGE ATTACHMENT

An inside micrometer which may be furnished with base attachments for converting it into a height gage or instrument for detecting misalignment between surfaces has recently been placed on the market by the Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. The micrometer is regularly supplied with five rods and a spacer that enable the taking of measurements from 2 to 7 inches, but additional spacers may be furnished for taking measurements up to 32 inches. The minimum setting of the micrometer permits the measuring of the smallest-sized automobile cylinders. The spindle has a ½-inch movement. The measuring rods are fitted with hardened tool steel anvils which are adjustable for wear, the rods being interchangeable on the threaded stud at one end of the micrometer head. The rods may be used singly or in combinations. A detachable handle adapts the micrometer to use with both right- or left-hand work.



Reed Micrometer with Height-gage Bases

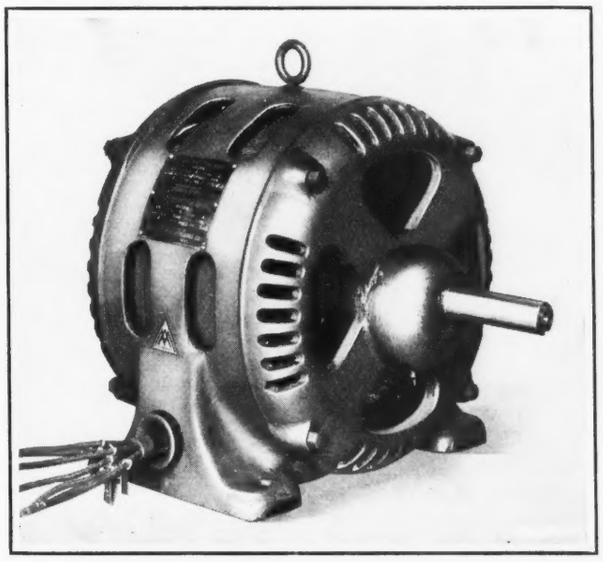
The micrometer can be quickly transformed into a height gage or misalignment detecting instrument by using the attachment shown at *C* and a rod. The micrometer is shown mounted on the attachment at *A*. The rod is inserted downward through the attachment until the anvil rests on the surface from which the measurement is to be taken, after which the quick-clamping knurled nut on the attachment is tightened by means of the fingers to hold the measuring rod firmly in position. When so arranged, the instrument is particularly useful in obtaining the height of projections and the locations of bushings in jigs, in measuring from the bottom of a groove to other surfaces in planer work, and in setting planer tools. The V-groove in the bottom of the base adapts the instrument to use with cylindrical parts as in measuring the distance between shafts for detecting misalignment. By inserting a drill rod in the base and attaching a standard indicator to this drill rod, a surface gage will be obtained that will be found useful in straightening shafts or in checking variations in the distance between surfaces. A scriber can be clamped to the rod.

The round base attachment shown at *B* is intended mainly for adapting the micrometer to ordinary height-gage applications. The upper end of the base is split vertically and may be adjusted to produce a friction on the measuring rod. This adjustment provides for eliminating side play should any wear take place on the parts from constant use. It also holds the base and the measuring rod together as the instrument is lifted from one surface to another.

WATSON MULTI-SPEED ALTERNATING-CURRENT MOTOR

A line of multi-speed alternating-current motors which afford speeds of 600, 720, 900, and 1200 revolutions per minute are now being introduced on the market under the trade name of "Watson," by the Mechanical Appliance Co., Milwaukee, Wis. Until recently the standard 4-speed windings for alternating-current motors gave 600, 900, 1200 and 1800 revolutions per minute on 60-cycle circuits, the two higher speeds being twice the two lower speeds. On this line of motors the narrower speed gap has been obtained by using an independent winding on the stator for each speed. In this manner speeds approaching those of direct-current motors are made possible.

The motor is of the squirrel-cage type and is said to carry a full rated load indefinitely without a temperature rise exceeding 40 degrees Centigrade, or a 25 per cent overload



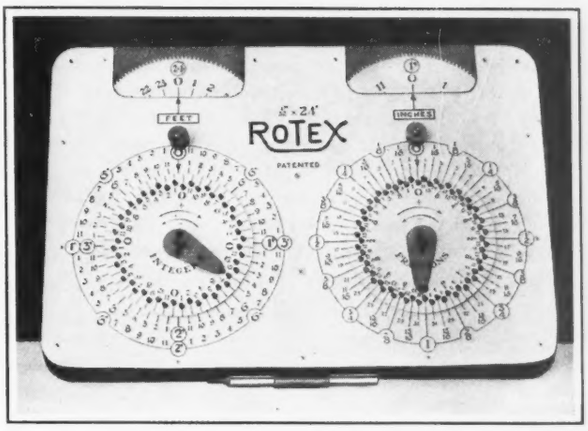
Watson Multi-speed Alternating-current Motor which may be run 600, 720, 900 and 1200 Revolutions per Minute

for two hours without a temperature rise of more than 55 degrees Centigrade. The motor is furnished for constant horsepower, constant torque, or any combination of both in two, three, or four speeds, for 60-cycle circuits. This motor may be supplied for both automatic and remote control. The speed range adapts the motor for driving some machine tools which previously could only be driven by direct-current motors.

LEINERT RAPID CALCULATOR

A rapid calculator for adding and subtracting feet and inches has been placed on the market by W. Leinert, 410 W. 23rd St., New York City, under the trade name of "Rotex." It will be seen from the illustration that the device has two circular scales, one of which is divided into forty-eight equal parts, and the other into sixty-four. The former is used in adding or subtracting integers of feet and inches, and the latter in dealing with fractions of an inch. The graduations of the scales are marked with black figures in clockwise sequence for use in adding, and with red figures in counter-clockwise sequence for use in subtracting.

Within each scale is a circular rotative disk that is graduated at its periphery to correspond with the graduations of the scale. Each disk is mounted on a pinion which engages a gear that may be seen in the slots near the top of the device, there being a provision for readily disengaging the gear and pinion. The disks have perforations that furnish a means for rotating them with a stylus supplied for the



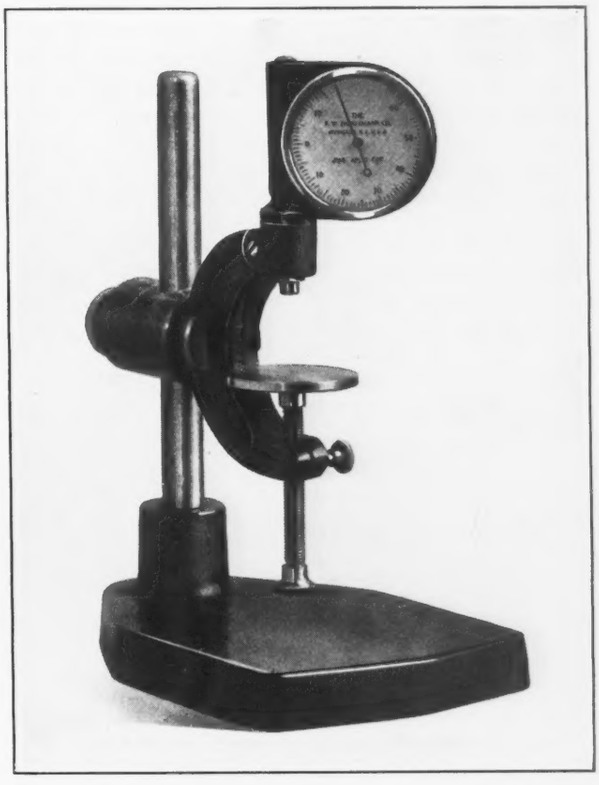
"Rotex" Calculator for adding and subtracting Feet and Inches

purpose. A rotative celluloid pointer mounted co-axially with each disk serves to indicate the last item of a calculation, in case of an interruption.

In using this calculator for adding sums, the disks are turned from the zero mark in a clockwise direction to proper divisions on the fixed scale having black figures. In subtracting, the disks are turned counter-clockwise to the proper divisions having red figures. The result in feet and inches is read at the zero marks. At each complete rotation of the right-hand gear a buzzer signals to indicate that a total of 12 inches should be transferred to the integer scale.

HORSTMANN INDICATING CALIPER

An indicating caliper having a head which may be swiveled about a complete circle and remains fixed in any desired position without the use of clamps, is now being manufactured by F. W. Horstmann Co., 196-210 Coit St., Irvington, N. J. The caliper may be supplied mounted on a stand as illustrated, or without this accessory. Except for the swivel head, the instrument is of the same design as the standard caliper made by the company. The dial graduations read



Horstmann Indicating Caliper with a Swiveling Head

to thousandths of an inch. The caliper is made in six sizes from 1 to 6 inches and each size has a range of 1 inch. It may be clamped on the post of the stand either in a straight or tilted position. Although the stand is sufficiently heavy for supporting ordinary work, holes may be drilled in the base for fastening to a bench to prevent it from tipping over. When used with a stand the caliper may be supplied with a larger anvil than is furnished on the instrument when it is intended for hand use. The caliper illustrated is equipped with the larger anvil.

* * *

NEW MACHINERY AND TOOLS NOTES

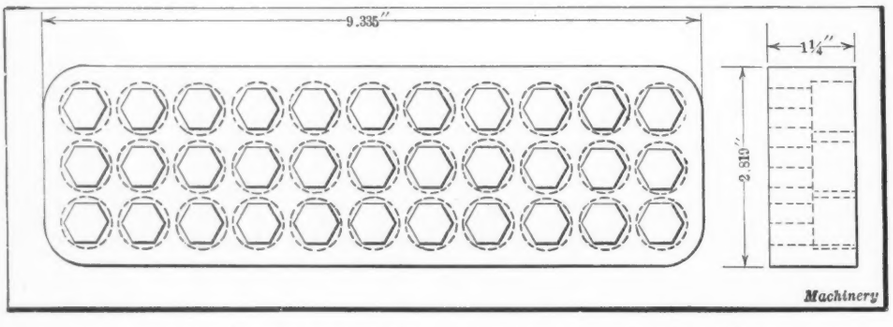
Lathe Sub-head: Hendey Machine Co., Torrington, Conn. An attachment for the standard lathes of this company's manufacture known as a "sub-head," designed to facilitate the cutting of worms, threads, hobs, etc., having unusually long leads. The attachment fits the inner vees of the lathe and is driven by special gearing attached to the spindle nose which gives a six to one reduction in speed relative to the lathe spindle. The faceplate turns on a hollow spindle, thus permitting the use of a dead center. The attachment is made for all Hendey lathes from 12 to 24 inches inclusive.

Magnetic Chucks: O. S. Walker & Co., Inc., Worcester, Mass. A line of magnetic chucks of the rectangular type for horizontal use, designed primarily for grinding machines made by the Diamond Machine Co., Providence, R. I., and the Norton Co., Worcester, Mass., but equally well adapted for other makes of similar capacity, as well as for planers and milling machines. The chucks are plain in style and have working surfaces ranging from 13¾ by 24 inches to 15 by 71½ inches. The range in weight is from 290 to 1150 pounds.

* * *

DRILLING HEXAGONAL HOLES IN A MOLD FOR BAKELITE PARTS

The cost of making a mold for producing small bakelite insulators in quantities of thirty-three at a time was greatly reduced through the use of hexagonal drills manufactured by the Watts Bros. Tool Works, in machining the holes in which the insulators are molded. These insulators measure 0.580 inch across flats and ⅜ inch in thickness. They are used in large quantities by the electrical industry. From the illustration it will be seen that the holes are arranged in parallel rows. The center to center distance between any adjacent holes of a row is 0.8145 inch, and the depth of the hexagonal portion of each hole, ⅝ inch. The tolerance on the dimension across the flats of a hole was 0.001 inch. The mold was machined from Ketos tool steel, and hardened and ground to fit a steam jacket. It has been estimated that twenty-eight days would be required to make this mold if the hexagonal holes were produced by drifting and filing after round holes had been drilled. This method would ordinarily have been applied to this work, because the mold had to be made in one piece. However, by drilling the hexagonal holes by means of the hexagonal drills and a jig plate, the mold was made in three days.



Construction of Mold for producing Bakelite Insulators, the Hexagonal Holes of which were machined by employing Hexagonal Drills

NEW BOOK ON INTERCHANGEABLE MANUFACTURING

PRINCIPLES OF INTERCHANGEABLE MANUFACTURING. By Earle Buckingham. 254 pages, 6 by 9 inches; 211 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $3.

The purpose of this book is to present a complete and comprehensive treatise dealing with the subject of interchangeable manufacturing as a whole. Such a book has not heretofore been available to those interested in interchangeable manufacturing in the machine building and metal working fields, although many articles dealing with various phases of interchangeable manufacturing have appeared from time to time in the technical press.

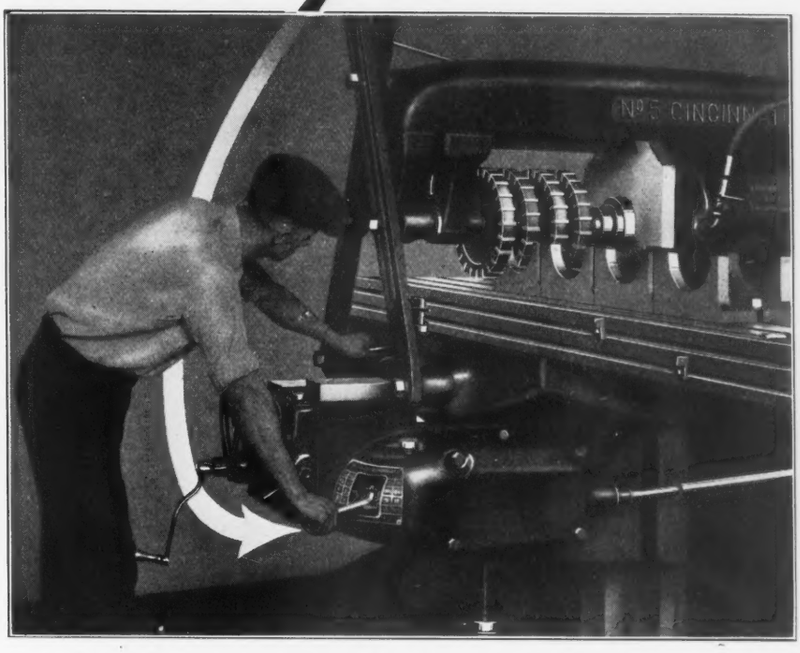
The development of interchangeable manufacturing is closely interwoven with many distinctly American manufacturing methods and processes and every large American industry has contributed its share to the progress made along this line. Different plants working independently have often achieved the same results by widely different methods. The author has attempted to define and emphasize the underlying basic principles, using specific examples only when necessary to illustrate the application of these principles in actual manufacturing processes. The information upon which this treatise is based has been gathered from many manufacturing plants, both large and small, in this country and in Canada; but the author mentions especially the Pratt & Whitney Co., Hartford, Conn., with whose cooperation this treatise has been written. The author has seen every method discussed in successful operation, some in one plant, and some in another. For more than ten years he has been in constant touch with many of the detailed manufacturing problems that arise in the production of interchanegable mechanisms in large quantities. During the war his activities in many manufacturing plants in connection with ordnance work made it apparent to him that the absence of common methods of interpretation of drawings, tolerances, and specifications, the lack of uniform gaging methods and misunderstanding of many of the factors of interchangeable manufacturing, presented an urgent need for a complete treatise on this subject.

In the arrangement of the material available on the subject of interchangeable manufacturing, the general principles involved in the industrial application of this method of production have been taken up first, and a separate chapter has then been devoted to the definition of the terms used, so that there will be no misunderstanding as to the meaning of the terms occurring later in the book. The influence of interchangeable manufacturing processes on machine design and the purposes of models are then dealt with, followed by a complete and minute discussion on the dimensioning of drawings intended for use in interchangeable manufacturing. This is followed by a discussion of the principal elements that govern mechanical production, the equipment required for interchangeable manufacturing (including machines, jigs and fixtures); the gaging equipment necessary; and the principles of inspection and testing.

Special chapters are also devoted to the subjects of manufacture for selective assembly, and methods used in small quantity production on an interchangeable basis. An entire chapter deals with the service factor in interchangeable manufacturing, because no manufactured machine is purchased for itself alone, but for the service it is supposed to render.

If it wasn't easy he wouldn't do it—

But it is easy—and so this operator on the No. 5 Plain Cincinnati constantly changes the feed rate to suit the cut—and saves much time thereby

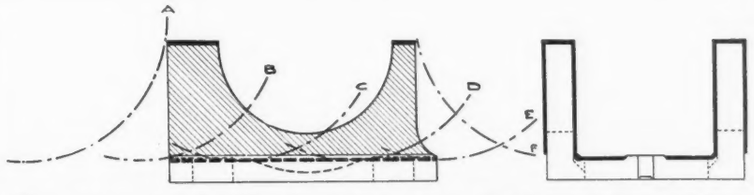


It is all done by the one lever in his right hand. He controls the table quick traverse with his left hand.

In rough milling these castings the operator, *using the single lever at the front of the knee,* makes ten feed changes across the four pieces.

He starts with 5½ in., then changes down to 3 in. at B, then up to 5½ in. again at C, and so on through the job.

If it wasn't easy he wouldn't do it. But it is easy. He simply moves one lever. He doesn't leave his position; and both operator and machine inevitably produce more.



The work consists of milling the surfaces shown shaded and in heavy outline. The size of the cut varies and the feed is changed to suit the cut.

This will apply to your work. Let our Service Department show you.

The Cincinnati Milling Machine Co.

Cincinnati, Ohio

PERSONALS

R. D. SHIELDS has been appointed assistant general manager of the Ohio Machine Tool Co., Kenton, Ohio. Mr. Shields has been chief engineer of this company for several years and will continue in that capacity.

EDWARD R. ABBOTT, formerly New York representative for the Taft-Peirce Mfg. Co., is now with the DuPont Engineering Co., Wilmington, Del., as sales representative for their Wilmington shops recently opened to contract work.

L. C. BULLINGTON, who has been assistant to the manager of the Power Department of the Westinghouse Electric & Mfg. Co., has been made assistant manager and will have charge of the general work of the Power Department.

J. G. BENEDICT, general manager of the Landis Machine Co., Waynesboro, Pa., sailed July 8 for a combined business and pleasure trip abroad. Mr. Benedict will be gone for about two months and his itinerary will include England, France, Holland, Belgium, and Germany.

CHARLES H. BLUSKE has been appointed district sales manager of the Los Angeles office of the Economy Fuse & Mfg. Co., Chicago, Ill. The Los Angeles office is at 1304 Maltman Ave. Mr. Bluske was formerly connected with the Pacific States Electric Co. of Los Angeles.

P. J. CONNOR, formerly traveling representative for the International Machine Tool Co., Indianapolis, Ind., manufacturer of the Libby turret lathe, and recently connected with the Essley Machinery Co., Chicago, Ill., is now engaged, in an engineering capacity, with the Haynes Stellite Co. with headquarters in New York.

S. GLEN VINSON, secretary and general manager of the Ideal Electric & Mfg. Co., Mansfield, Ohio, sailed recently for the Orient where he will make a survey of business conditions. Mr. Vinson will visit all the larger cities in Japan, China, Philippine Islands, and India. He expects to return to the United States about October.

R. S. GILDART of Cleveland, Ohio, has become advertising manager of the General Fireproofing Co., Youngstown, Ohio. Mr. Gildart was formerly director of publicity for the American Malleable Castings Association, Cleveland, prior to which he was advertising manager for the P. B. Yates Machine Co., Beloit, Wis., and the Kelvinator Corporation, Detroit, Mich. The General Fireproofing Co. is engaged in the manufacture of steel office furniture, filing equipment, concrete reinforcements, etc.

C. F. FORD, for several years with the Chicago Pulley & Shafting Co. has recently become connected with the engineering sales force of the W. A. Jones Foundry & Machine Co., Chicago, Ill., manufacturer of speed reducers and power transmission machinery. Mr. Ford will be located in the near future in Minneapolis as manager of the company's branch there. Some years ago Mr. Ford was transmission engineer for the W. A. Jones Foundry & Machine Co., and acted in that capacity over an extended period.

W. H. WHITE has been appointed New York representative of the Mahr Mfg. Co., Minneapolis, Minn. He will have offices at 56 Murray St., New York City. The Mahr Mfg. Co. manufactures the "Mahrvel" line of oil-burning equipment, rivet forges, torches, and furnaces. Mr. White until recently was associated with the Mushet Steel and Taylor Iron interests in the United States and Canada. His experience in the iron and steel business during the last ten years will be useful to him in dealing with heat-treating problems.

* * *

OBITUARY

W. H. HOLLAND, president and general manager of the Sibley Machine Co., 8 Tutt St., South Bend, Ind., who died Wednesday, June 14, was prominently identified with many manufacturing companies in South Bend and northern Indiana, and had also several other business interests, serving as vice-president of the Citizens' National Bank of South Bend. He was also president of the Motor Casting Co., president of the Elkhart Iron Works, president of the Clover Leaf Mfg. Co., vice-president of the South Bend Bait Co., and a director of the American Earth Works. Mr. Holland was born in Florena, Neb., June 4, 1866. He came to South Bend with his parents when five years old, and at the age of fourteen he started to work at the Sibley & Ware Mfg. Co. Mr. Holland is survived by his wife and his daughter, Mrs. Bernard Voll of Cambridge, Mass.

* * *

TRADE NOTES

ALBRO-CLEM ELEVATOR CO. 500 Erie Ave., East, Philadelphia, Pa., announces that it has moved its district sales and service office in New York City to 165 Broadway.

ECONOMY FUSE & MFG. CO., Chicago, Ill., announces that the Pittsburg sales office of the company has been moved from 2223 Farmers Bank Bldg., to 1006 Peoples Bank Bldg., at Fourth Ave. and Wood St.

MARVIN & CASLER CO., Canastota, N. Y., manufacturer of Casler boring heads and chucks announces that it has taken over the manufacture and selling of the castellating and hexing machine designed by the Manufacturers' Consulting Engineers of Syracuse, N. Y.

S. & S. MACHINE WORKS, 4522 Lexington St., Chicago, Ill., has been formed by E. V. Swangren, formerly vice-president and superintendent of the F. J. Littell Machine Co., and W. N. Stevenson, formerly secretary and chief engineer of the same company. The partnership has been formed for the purpose of engaging in engineering and machine shop work.

BASTIAN-BLESSING CO., W. Austin Ave. at La Salle St., Chicago, Ill., manufacturer of Rego welding and cutting apparatus has taken over the entire output of the St. Paul Welding & Mfg. Co.'s line of soldering equipment, trucks, preheaters and acetylene generators. The St. Paul Welding & Mfg. Co. will be the service distributors of Rego welding and cutting equipment and supplies at St. Paul, Minn.

HABERKORN & WOOD is the name of a partnership formed by A. C. Haberkorn, formerly Detroit branch manager of Manning, Maxwell & Moore, Inc., and the Biggs-Watterson Co., and E. E. Wood, formerly sales manager of the Jones & Lamson Machine Co. An office and warehouse have been opened at 620 E. Hancock Ave., Detroit, Mich. The firm will handle a line of machine tools, cutting oils and compounds, as well as permanent mold aluminum alloy castings.

COMING EVENTS

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

September 4-9—Annual meeting of the American Chemical Society at Pittsburg, Pa. Further information may be obtained from R. S. Clark, office of the secretary, Carnegie Institute of Technology, Pittsburg, Pa.

September 11-15—Sixteenth annual convention and fourth annual exhibition of the Association of Iron and Steel Electrical Engineers at Cleveland Public Hall, Cleveland, Ohio. John F. Kelly, secretary, Empire Building, Pittsburg, Pa.

September 11-16—Eighth national exposition of chemical industries in the Grand Central Palace, New York City. Managers, Charles F. Roth and Fred W. Payne, Grand Central Palace, 46th St. and Lexington Ave., New York City.

October 2-7—Annual convention and exposition of the American Society for Steel Treating in Detroit, Mich., General Motors Bldg. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

October 26-27—Automotive production meeting of the Society of Automotive Engineers to be held in Detroit. Further information may be obtained from the Society of Automotive Engineers, 29 W. 39th St., New York.

December 4-7—Annual convention of the American Society of Mechanical Engineers, in the Engineering Societies Bldg., 29 W. 39th St., New York City. Calvin W. Rice, secretary.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St., and Lexington Ave., New York.

SOCIETIES, SCHOOLS AND COLLEGES

New York University, New York City, announces two series of lectures which will be given at the University, one on the Geology of Commerce and Industry, and one on the Commercial Geology of the Metals. Further information may be had by writing the secretary of the School of Commerce, New York University, Washington Square, or to Dr. Ernest R. Lilley, New York University, University Heights, New York City.

Pennsylvania State College, State College, Pa. Bulletin describing a course in Industrial Organization and Administration, which will be held at the State College from August 28 to September 9, under the direction of Professor Edward J. Kunze, assisted by Professors J. O. Keller and P. P. Henshall of the Department of Industrial Engineering. Complete information may be obtained by addressing Professor Edward J. Kunze, State College, Pa.

NEW BOOKS AND PAMPHLETS

Trade Standards in the Pump Industry. 21 pages, 6 by 9 inches. Published by the Hydraulic Society, 50 Church St., New York City.

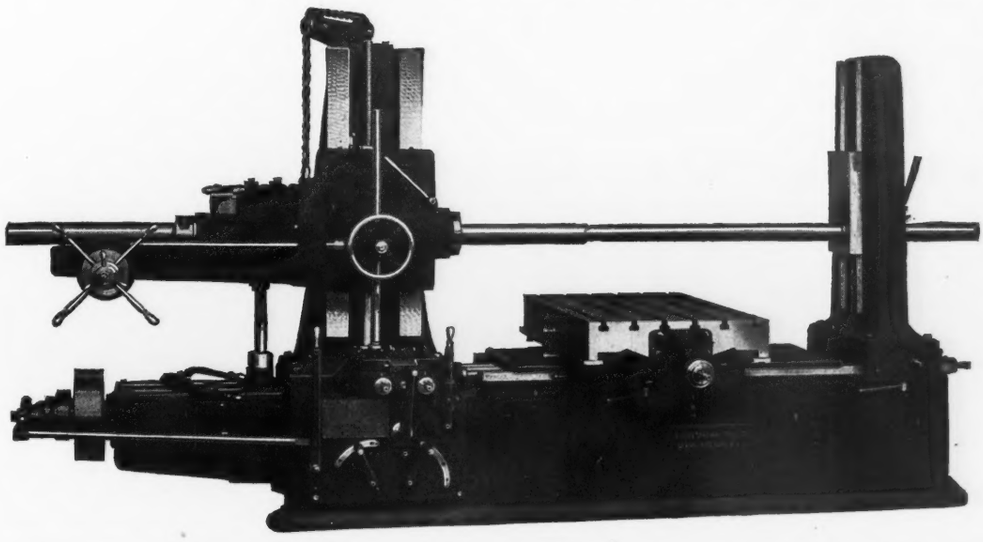
Interference Methods for Standardizing and Testing Precision Gage-blocks. By C. G. Peters and H. S. Boyd. Scientific Paper No. 436 of the Bureau of Standards, Washington, D. C. 36 pages, 7 by 10 inches. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 10 cents.

Metallographic Etching Reagents. By Henry S. Rawdon and Marjorie G. Lorentz. Scientific Paper No. 435 of the Bureau of Standards, Washington, D. C. 41 pages, 7 by 10 inches. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 15 cents.

Distance lends enchantment to—lots of things but NOT to the

"PRECISION"

Boring, Drilling and MILLING MACHINE



The closer you get, and the more you know it, the better you like it; it has no tricks to plague you either before or after you get familiar with it, which does not take long, because

IT IS SIMPLE

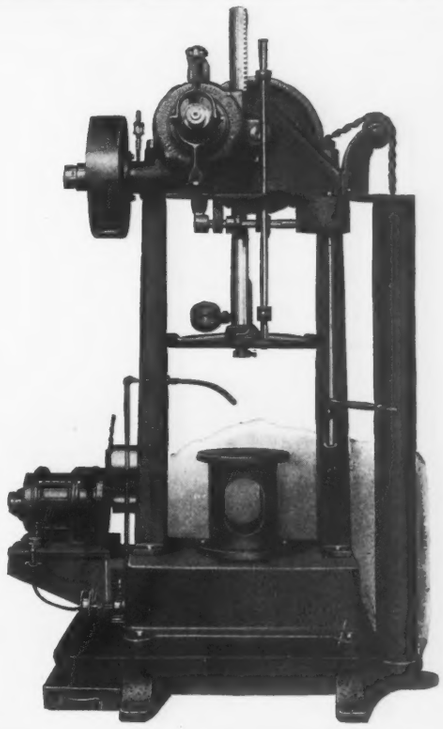
Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

"A SIMPLE TWIST OF THE WRIST" DOES THE TRICK

Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anoyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Company, Turin, Barcelona, Zurich. Benson Brothers, Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Company, Tokyo, Japan.

How to Make Commercial Type Radio Apparatus. By M. B. Sleeper. 159 pages, 5¼ by 7¾ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 75 cents.

A man who builds and designs his own radio equipment often wishes to compare it with the equipment of commercial design, and it is for this purpose that this guide book has been issued, which gives information in compact form on commercial type radio apparatus. The book describes in detail many commercial types of transmitting spark and vacuum tube sets, both telephone and telegraph, and receiving equipment of all kinds. There are ninety-eight illustrations, which make it easy for the experimenter to follow the descriptions.

Notes on Mechanical Drawing. By Rolland S. Wallis. 64 pages, 6 by 9 inches; 87 illustrations. Published by the Engineering Extension Department, Iowa State College, Ames, Iowa. Price, 50 cents.

This is a supplement to the drawing courses conducted by the Engineering Extension Department of the Iowa State College. It gives a general survey of the principles of mechanical drawing, reviewing the instruments required and their use, and devoting considerable space to freehand lettering as well as lettering produced by drawing instruments. It then briefly reviews the standard methods of projection, dimensioning, and the drawing of simple machine details. It closes with a useful chapter on drafting-room geometry.

Industrial Unionism in America. By Marion Dutton Savage. 344 pages, 7½ by 5 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $2.25.

In this book, as stated in the preface, an attempt has been made to describe unionism, with its many variations, and to consider the direction in which organized labor seems to be moving. The author has assumed on the part of the reader some knowledge of the many reasons for the existence of the labor movement. No attempt has been made to justify or condemn the fact of organization among the workers. The subject matter is divided into three main heads as follows: Industrial Unionism within the American Federation of Labor; Revolutionary Industrial Unionism including Workers of All Industries; and Independent Industrial Unionism.

Iron and Steel. Pamphlet published by the Bureau of Education of the United States Department of the Interior, Washington, D. C. Sent free on application.

This pamphlet contains an outline of a reading course on the manufacture of iron and steel, including information on blast furnaces and treatises on the metallurgy of steel. The pamphlet is prepared by the American Library Association for the Bureau of Education of the United States Department of the Interior. It lists fourteen books, which form a course covering the whole iron and steel industry. Among the books included are "Iron and Steel," published by The Industrial Press, 148 Lafayette Street, New York City, which contains a complete outline of the entire subject of the manufacture of iron and steel of different kinds—wrought iron, open-hearth steel, bessemer steel, tool steel, high-speed steel, electric steel, steel castings, gray iron castings, malleable iron, etc.

Handbook of the Electric Power Club. 284 pages, 4 by 7 inches. Published by the Electric Power Club, 1017 Olive St., St. Louis, Mo.

This is the fourteenth edition of the handbook of the Electric Power Club, an association of manufacturers of electric power apparatus and control equipment, organized for the standardization, improved production, and increased distribution of electrical machinery and apparatus. The handbook covers substantially all of the standardization thus far accomplished by the Electric Power Club and its predecessor, the American Association of Electric Motor Manufacturers, which was organized in 1908. The handbook contains a mass of valuable information for those who use electric power apparatus. For example, it contains information relating to pulley sizes, belt speeds, methods of gearing motors, etc. It should be of especial value in connection with the providing of motor drives for machine tools and industrial machinery in general.

Steam Turbines. By William J. Goudie. 804 pages, 8½ by 5½ inches. Published by Longmans, Green & Co., 55 Fifth Ave., New York City. Price, $10.

This is the second edition of Professor Goudie's book on steam turbines. As it was considered that a mere revision would not bring the book thoroughly up to date, it has been almost entirely rewritten. While the general scheme of the first edition has been followed, the addition of new material has increased the number of chapters from sixteen to eighteen. The thermodynamic portion is based on Callendar's characteristic equations for steam, and four diagrams giving the properties of superheated and supersaturated steam are included. A new chapter has been added on mechanical reduction gears, with special reference to marine turbines. The section on critical speeds of rotors has been extended to include the multiple bearing case. Improved methods of dealing with the condition curve, reheat factor, internal efficiency, and also new methods of provisional design have been developed. The book is intended for the use of engineers engaged in the design or operation of steam turbines, as well as for engineering students.

Radio Experimenter's Handbook. By M. B. Sleeper. 143 pages, 6 by 4 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.

The purpose of this book is to answer the practical problems that confront those who are beginning to experiment in the radio field. All deeply theoretical and mathematical discussions have been omitted, and the apparatus considered is limited to simple and practical instruments capable of receiving signals from broadcasting stations as well as from radio telegraph stations. The material is divided into sixteen chapters as follows: What is the Use of Having a Radio Station?; What Makes the Wireless Work?; Apparatus Used in Simple Damped Wave Transmitting Sets; Setting up and Operating a Damped Wave Transmitter; Apparatus Used in Simple Damped Wave Receivers; Setting up and Operating a Simple Damped Wave Receiver; Radio Antennas and Grounds; Advanced Damped Wave Receiving Apparatus; How Does an Audion Work?; Damped Wave Audion Receiving Apparatus; Advanced Damped Wave Audion Receiving Apparatus; What is an Undamped Wave?; Undamped Wave Telegraph and Telephone Transmitters; Undamped Wave Receivers; the Audion Amplifier; Radio Rules and Regulations.

Production Engineering and Cost Keeping. By William R. Basset and Johnson Heywood. 311 pages, 6 by 9 inches; 117 illustrations. Published by the McGraw-Hill Book Co., 370 Seventh Ave., New York City. Price, $3.50.

The purpose of this book is not only to give practical assistance to production managers, foremen and cost accountants of machine shops, but also to furnish higher executives with a knowledge of the best in shop management practice. The principles and practice recommended have been developed in the course of years of actual installation of improved production, engineering, and cost keeping systems in metal trades plants. While no system, however successful in one shop, can be applied in its entirety in another shop, the underlying principles of management are essentially the same. A better idea of the contents will be obtained from the following chapter headings: What Production Planning Does; Purchasing as a Tool of Production; Need for Systematic Stock Keeping; Engineering the Product; Tool Issue; Laying out the Machines; the Central Control of Production; Controlling the Work in the Shop; Planning in the Jobbing Shop; the Fundamentals of Correct Time Study; Setting the Standard; Setting Piece Rates; Special Cases of Time Study and Rate Setting; Time Study on Automatic Machines; What a Cost System Can Do for You; the Fundamentals of Cost; Fixed Charges; Departmentalizing the Overhead Expense; Analyzing the Labor Costs; Accounting for Supplies; Getting the Overhead into the Finished Product; Handling Abnormal Expense; Gathering the Final Costs; the Statement of Condition and the Operating Statement; What Does it Cost to Sell?; Graphic Methods of Control.

NEW CATALOGUES AND CIRCULARS

New Departure Mfg. Co., Bristol, Conn. Folder entitled "New Departure Ball Bearings Win."

Monitor Controller Co., Baltimore, Md. Folder illustrating and describing the expansion unit of the Monitor thermaload starter.

Reading Chain & Block Corporation, Reading, Pa. Folder illustrating and describing the company's new "Everedy" electric hoist.

Ingersoll Milling Machine Co., Rockford, Ill. Bulletin entitled "The Ingersoll Adjustable Rail Milling Machine," illustrating and describing this machine and showing operations performed on it.

Hendey Machine Co., Torrington, Conn. Folder illustrating and describing the Hendey sub-headstock, the primary purpose of which is to permit the chasing of screw threads having unusually long leads.

Jas. Clark, Jr., Electric Co., Louisville, Ky. Jasco Driller, a periodical published by the company, illustrating and describing its products and giving instructions for the care and maintenance of portable electric drills.

Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. Bulletin No. 57 illustrating and describing the company's radius-link grinding machine. The folder gives a table of general dimensions and specifications.

Schutte & Koerting Co., Philadelphia, Pa. Catalogue entitled "Koerting Fuel Oil Burning Systems," describing mechanical fuel oil-burning systems and fuel oil-burners in which the oil is atomized by low or high pressure air and steam.

W. C. Lipe, Syracuse, N. Y. Catalogue illustrating and describing in detail the Lipe automatic gear tooth chamfering machine, and showing some of the work done on it. Complete instructions for operating the machine are also included.

Brown Instrument Co., Philadelphia, Pa. Catalogue of resistance thermometers, explaining the theory of resistance thermometry, and illustrating and describing the various types of instruments made. The advantages and applications of each type are indicated.

Birdsboro Steel Foundry & Machine Co., Birdsboro, Berks County, Pa. Booklet illustrating and describing the Jackson belt lacer, showing clearly both the type of belt chains that results from the use of this belt lacer, and the method in which the belt lacer is applied.

Western Tool & Mfg. Co., Springfield, Ohio. Catalogue 19 of expanding mandrels, tool-holders, lathe dogs, C-clamps, shop furniture, emery wheel dressers, and vises. The catalogue is profusely illustrated, showing all the tools and devices manufactured, and giving complete lists of sizes and prices.

American Nickel Corporation, Clearfield, Pa. Bulletin No. 101 entitled "American Nickel—Its Properties and Uses." The bulletin gives a resume of the properties of the nickel products of the company and a list of purposes for which it is recommended, and contains a number of useful tables.

Acme Motor Truck Co., Cadillac, Mich. Catalogue for 1922, of Acme motor trucks, illustrating and describing seven models of the company's make. The catalogue is profusely illustrated, and gives complete description of the separate models; it also shows the construction of the prominent features of the Acme trucks.

Van Keuren Co., 362 Cambridge St., Boston, 34, Mass. Catalogue of modern measuring tools, illustrating, describing and giving prices of combination precision gage-blocks, gage-block accessories, plug gages, measuring wires for screw threads and profiling gages, lapped steel surface plates and light-wave measuring outfits.

Condensite Co. of America, Bloomfield, N. J. Catalogue entitled "Condensite in the Automotive Industry," illustrating and describing the various purposes for which condensite is used in automobile construction. Also catalogue treating of "Halowax Oil" in the rubber industry. This oil is used in the treatment of fabric to improve the bonding of rubber to it.

Kelly Lubricator Corporation, 107 N. Franklin St., Syracuse, N. Y. Folder illustrating and describing Auto-vac ball feed lubricators manufactured by the company for automatic, positive and economical lubrication. These lubricators are used on various types of machine tools and line-shafting. Loose-pulley lubricators are also illustrated and described.

General Welding & Equipment Co., 74 Brookline Ave., Boston, Mass. Catalogue entitled "Modern Welding and Cutting," illustrating and describing the "Gewe" automatic welding machines and automatic cutting machines. The automatic welding machine described is an entirely new design, having a self-feeding welding torch; numerous illustrations, showing the application of the apparatus, are included.

Philadelphia Gear Works, 1124 Vine St., Philadelphia, Pa. Catalogue for 1922 covering generated spur, bevel and spiral gears, rawhide and micarta pinions, worms and worm-gears, racks and lead-screws, speed-reducing units, sprockets and "Diamond" chains. In addition to the information about the company's product, the book contains a great deal of information on gearing, and a number of tables and formulas of use to gear designers and shop men.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Catalogue entitled "Link-Belt Power Hoe," describing a new patented improved drag scraper, intended for use in storing and reclaiming materials. Bulletin describing the Link-Belt crawler crane, the newest machine that has been brought out by the Link-Belt shops in Chicago. This crane complete, without bucket, weighs twenty-two tons, and lifts safely ten tons at a 12-foot radius and three tons at a 30-foot radius.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., Bulletin entitled "Arc Welding in Electric Railway Shops," known as Leaflet No. 1824. This publication describes the many advantages of arc welding, and gives figures showing the savings made possible by reclaiming worn out parts. The increased technical knowledge regarding the arc welding operation has extended the scope of the process, and the improvements in welding equipment, many of which are described in this bulletin, have greatly increased welding efficiency.

Colburn Machine Tool Co., Cleveland, Ohio. Bulletin B-103 entitled "Colburn Heavy-duty Boring and Turning Mills." This bulletin gives a very complete description of the new design of Colburn boring and turning mills together with halftone illustrations of the machines on which different parts are named for ready identification. A number of detail views of the most important mechanisms of the machines are also included, showing clearly the method of control and operation. A phantom view of the machine illustrates in a very good manner the lubricating system.

Metals Coating Co. of America, 495-497 North Third St., Philadelphia, Pa. Catalogue entitled "Schoop Metal Spraying Process," illustrating and describing the process and apparatus used for simultaneously melting and atomizing any of the commercial metals, impacting them on any surface so as to apply thereby a coating of any commercial metal on any surface according to the requirements. The catalogue completely illustrates and describes the process and the apparatus used in connection with it, and shows in addition the photographs of a number of applications in actual practice.

VOLUME 28 **MACHINERY** NUMBER 12

AUGUST, 1922

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE ST., NEW YORK CITY

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CIRCULATION FOR JULY, 1922, 19,000 COPIES

Member Audit Bureau of Circulations

September MACHINERY will be of more than ordinary interest. It covers a wide range of unusual subjects—Diamond Tools, Rivet Spinning, Bending Large Pipe, Metal Polishing, Molding Radio Insulators, Grinding Small Tools, Wire Forming, Cutting Bevel Gears, etc.

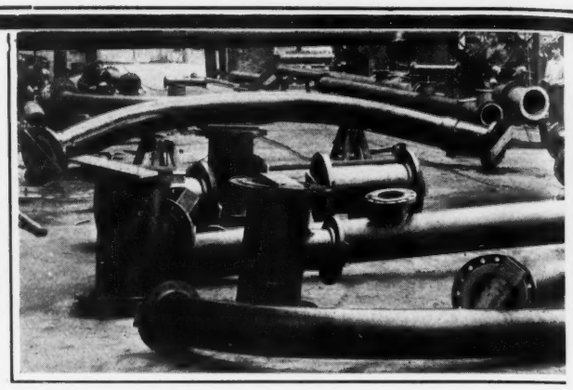
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Copyright 1922 by THE INDUSTRIAL PRESS. Entered as second-class mail matter, September, 1894, at the Post Office, in New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. It is understood that all contributed articles are submitted exclusively to MACHINERY; when accepted and published, payment is made at our regular space rates.

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What September

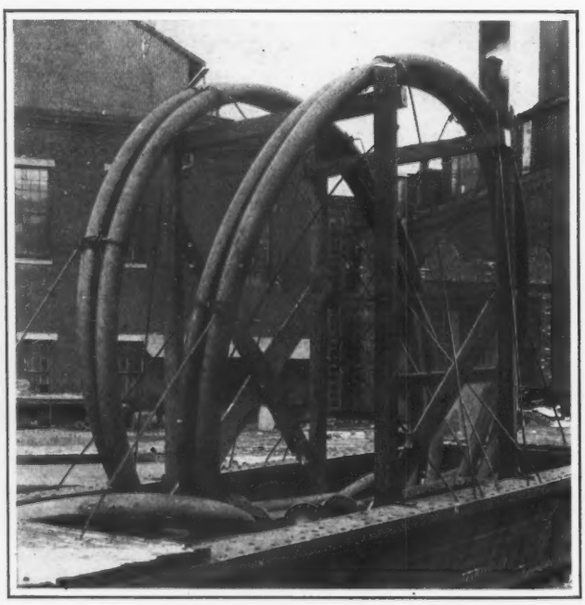


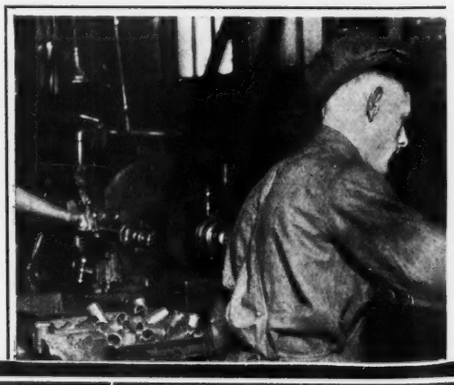


The September number of MACHINERY will be of more than ordinary interest because of the unusual subjects covered. The leading article "Bending Large Pipe" describes in detail the general practice for handling this work. Pipe up to 4 inches can be bent cold, by using machines designed for the purpose, but larger sizes must be heated. The heating process and the unusual methods employed to secure the desired shapes are extremely interesting and a great deal of skill is required to bend large pipe without flattening or buckling on the inside of the bend.

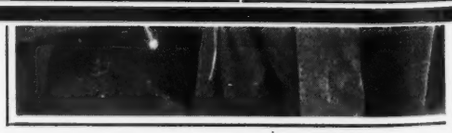
Another article—"Rivet Spinning"—deals with the use of rivet spinning machines for heading or "setting down" pins, studs and bushings as well as rivets.

September also marks the beginning of a series on the "Principle of Metal Polishing"—covering the subject of polishing thoroughly and completely. One of the prominent manufacturers in the polishing line has written a great part of the matter and the articles will cover the general points concerning metal polishing, polishing

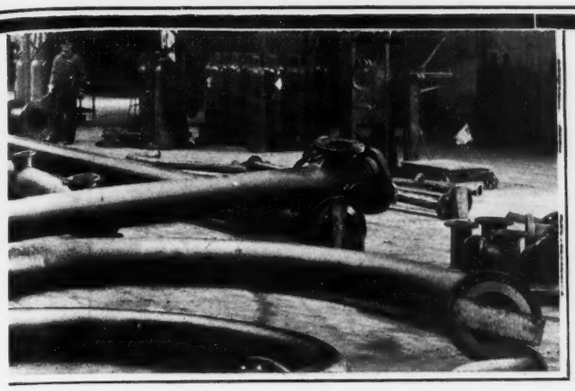


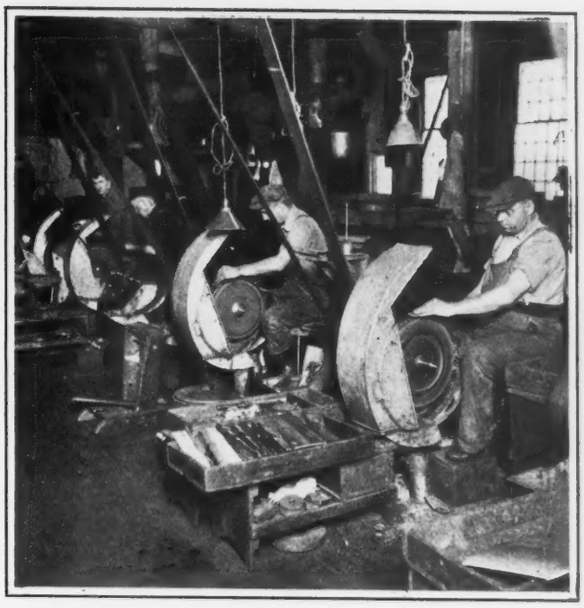


Latest Mechanical Developments



MACHINERY Offers



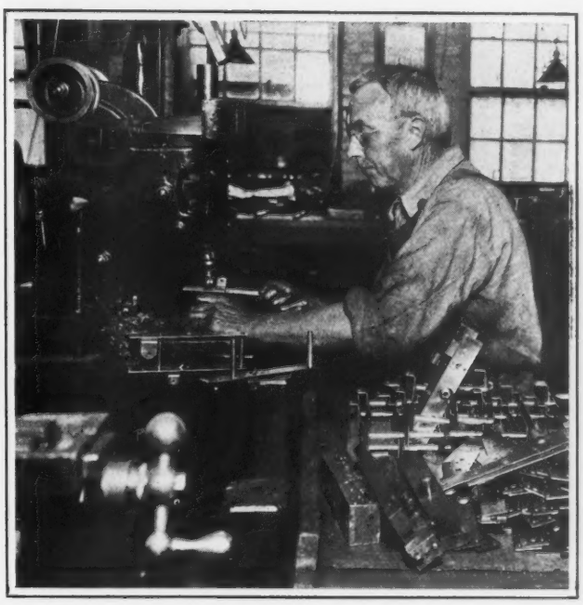


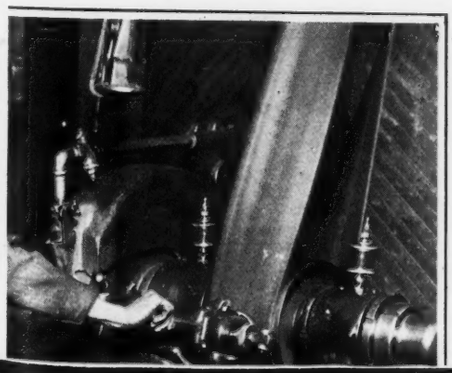
wheels and abrasives, polishing methods and equipment, the making of polishing wheels and special wheel shapes, together with a number of examples of polishing practice in different metal-working industries. Another instance where MACHINERY takes up a subject and deals with it completely in all its phases in a series of articles.

"Molding Radio Insulators" is another chapter in the series on making radio instruments, and includes a complete review of the dies and methods used in this work.

"Diamond Tools as Cost Reducers" indicates how diamonds may be used for cutting various materials, with special emphasis on the economies introduced by the application of diamonds as cutting tools.

"Grinding in the Small Tool Industry" continues the grinding series. The last installment of "Cutting Bevel Gears" and the second and last installment of "Wire Forming" appear in September, and the designer and draftsman will be especially interested in the article "Following up Alterations in Design."

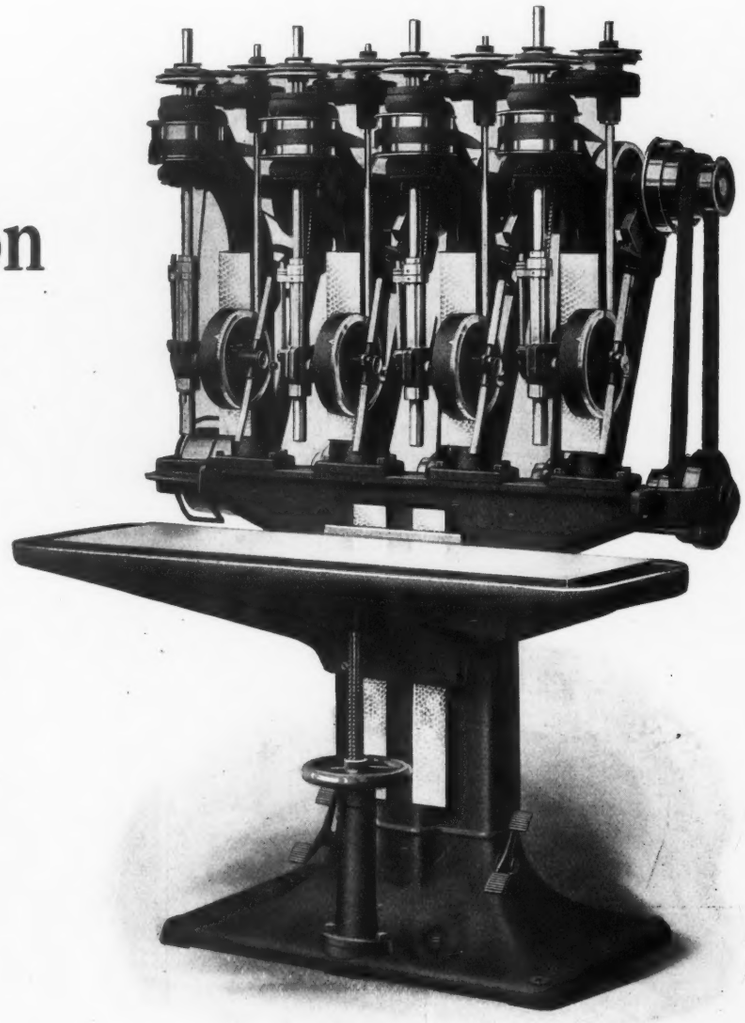




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Frame castings have the strongest section at the point of greatest stress.

The *rated* stroke and the *working* stroke are the same —the feed does not take up any part of rated stroke.

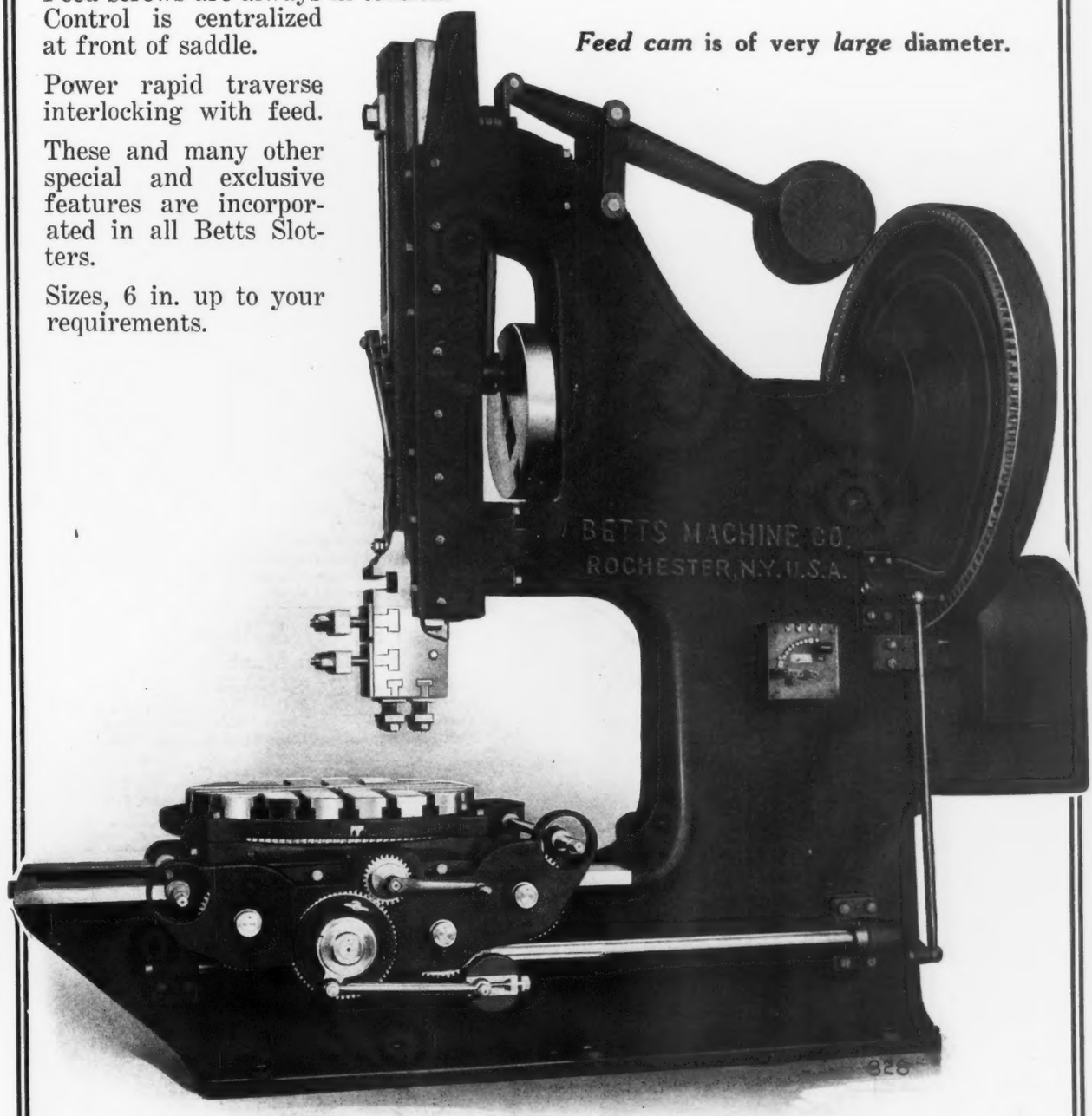
Feed screws are always in tension. Control is centralized at front of saddle.

Power rapid traverse interlocking with feed.

These and many other special and exclusive features are incorporated in all Betts Slotters.

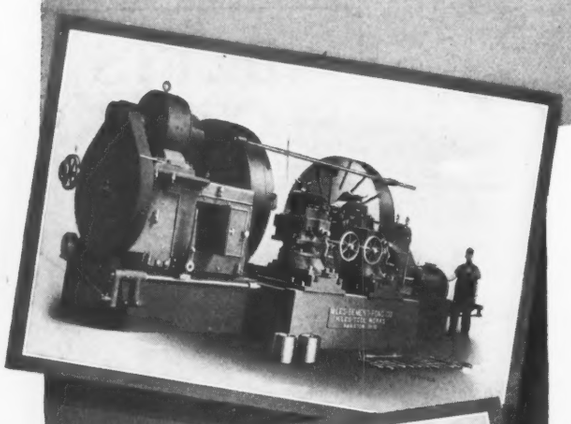
Sizes, 6 in. up to your requirements.

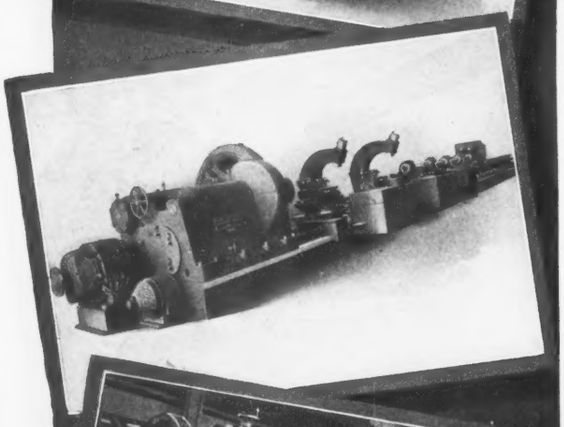
***Feed cam* is of very *large* diameter.**

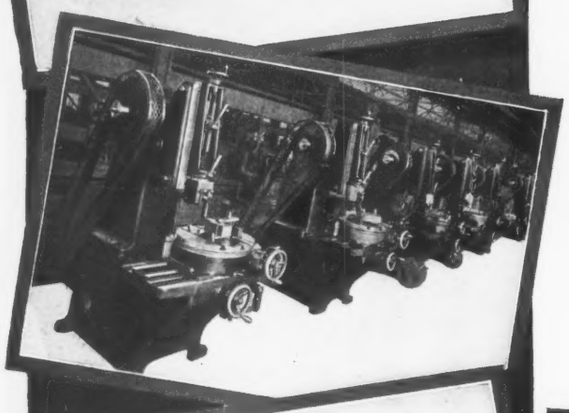


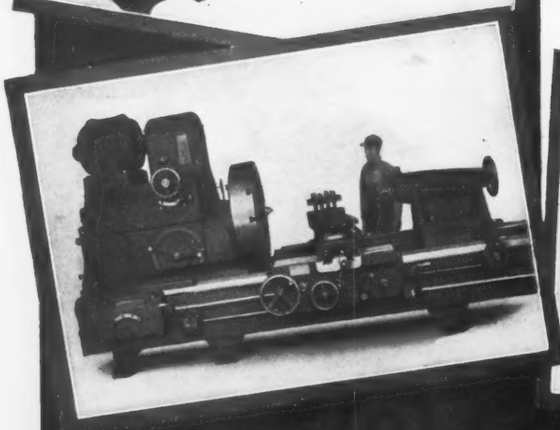
BETTS MACHINE CO., 400 Blossom Road, Rochester, N. Y.

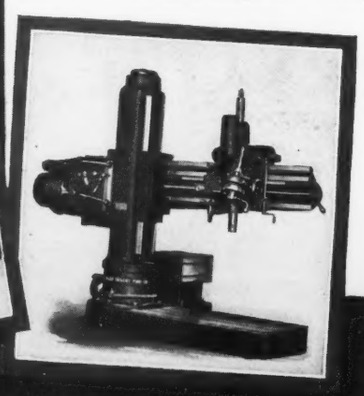
BETTS MACHINE TOOLS











Complete Machine

For General Manufacturing Railway Shops, Shipyards,

OUR eight factories, greatly enlarged and re-equipped within the past few years, are today manufacturing our extensive line of standard products to serve *all* your machine tool needs. We furnish *complete* machine tool and crane equipment for general machine shops, locomotive and car building shops, railroad repair shops, arsenals and shipyards. Our engineering departments have had wide experience in such installations and their services are at your disposal. We build

Engine and Forge Lathes—7 in. to 170 in. swing.
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GENERAL OFFICES:

Tool Equipment
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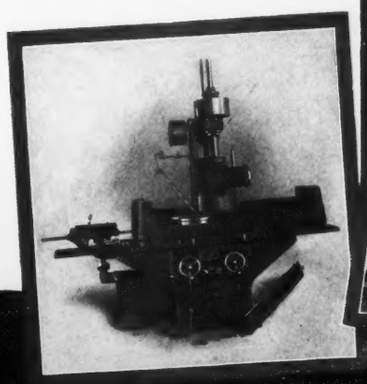
FOR over forty years our object has been to build the highest grade products only. The success of our efforts is best proven by the extensive use of Niles-Bement-Pond and Pratt and Whitney equipment not only in the United States and Canada but in most European countries as well as in India, Japan, China, Australasia, South Africa, South America, Java, etc.

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Traveling Head Shapers—Single and double.
Cylinder Boring Machines.

Steam Hammers—250 lbs. to 2500 lbs. falling weight.

PRATT & WHITNEY
Small Tools and Gages

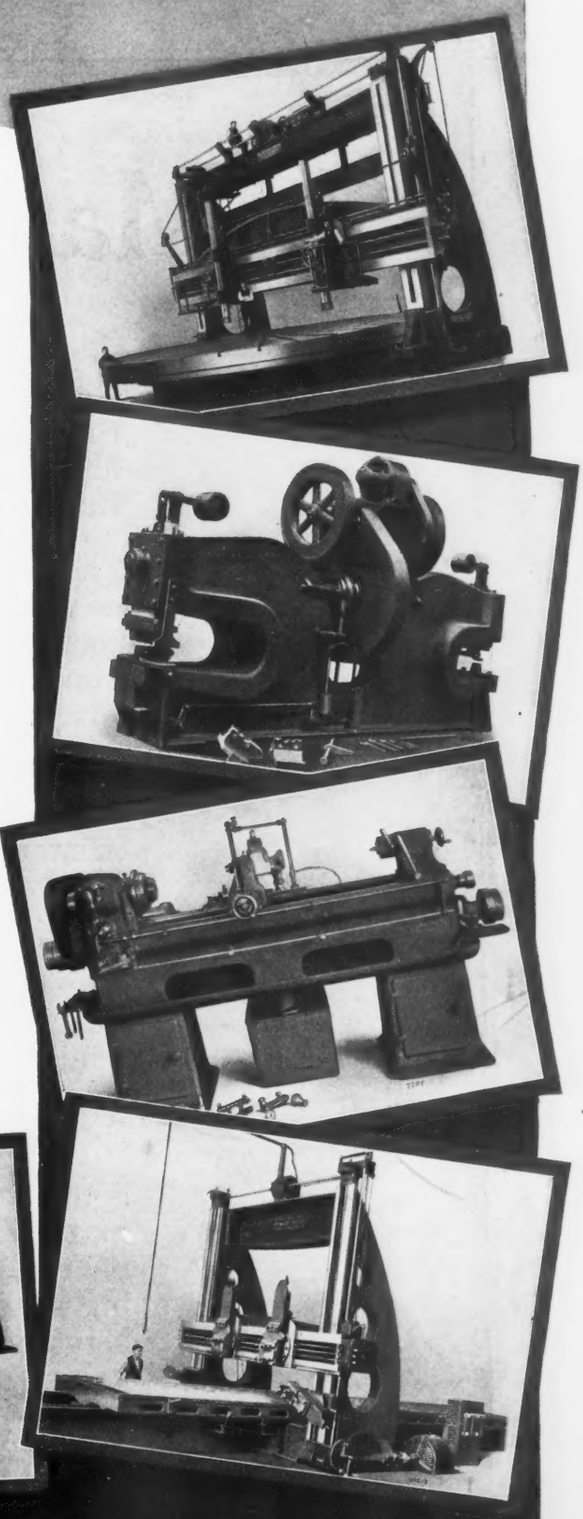
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Dies
Reamers, etc.
Milling Cutters
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POND COMPANY
111 BROADWAY, NEW YORK

A Masterpiece

Recently a man paid seven hundred and fifty thousand dollars for a picture. Just think, almost a million dollars for a painting! It was for a Gainsborough—"The Blue Boy."

The man who bought it undoubtedly knew what he was doing. He wanted this unusual picture and considered his purchase a real investment. To him, merely owning this painting was a source of complete satisfaction.

The fame of this picture has preceded it to this country and its value is tremendous. It is a masterful creation in many shades of blue. It is unique! A masterpiece in the world of art.

In some respects the mechanical world can be likened to that of art. It has its masterpieces. Machines that have demonstrated their sterling qualities year after year. There is a demand for these machines. Their fame has preceded them throughout the world.

Some of these days, perhaps, you will be in the market for a new machine—a lathe. If you are, bear in mind that the mere satisfaction of owning a "Blue Boy" is worth more than the value actually received from others.

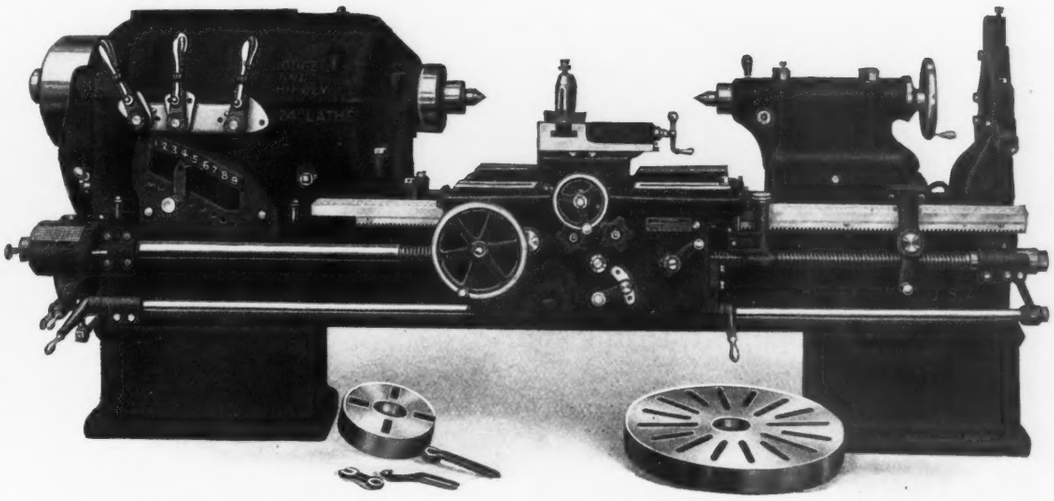
We know! Our customers tell us.

The Lodge & Shipley

Cincinnati,

LATHES

Good Lathes Only



The Lodge & Shipley Lathe

Made in sizes 14" to 60"
Our general catalogue tells all about it.
Care for one?

Machine Tool Co.

Ohio

BAUSH METAL
DURALUMIN

A Few Advantages
MACHINING

Better than aluminum.
Cost greatly reduced when compared with iron or steel.
Taps and threads well.

RECIPROCATING PARTS

Weight reduced without loss of strength.
Acceleration increased.
Inertia decreased.

Polishes easily.
Resists atmospheric conditions.
No plating required.

Can be rolled, forged, drawn, heat-treated and annealed.
Hot and cold worked.

A QUALITY METAL

Duralumin is an alloy produced after years of systematic endeavor to meet the demand for a metal which shall be as light as Aluminum and as strong as mild steel, yet without the many disadvantages of Aluminum in its pure state.

Duralumin is the only light metal that can replace steel in forgings. With a two-thirds saving in weight, heat-treated Duralumin Forgings approximate mild steel forgings in strength.

Wherever weight is a deciding factor Duralumin is the most satisfactory metal for most articles made by hot working or forging. Naturally, Duralumin Forgings are especially desirable for reciprocating or moving parts where inertia, due to their own weight, forms a large part of the total stress.

Minimum Physical Properties of Rolled or Sheet Metal (heat-treated) and of Forging Metal are:

Tensile .....55,000 lbs. per sq. inch
Elastic Limit ...30,000 lbs. per sq. inch
Elongation .....18%.

BAUSH MACHINE TOOL COMPANY
Metals Division
SPRINGFIELD, MASS., U. S. A.
Manufacturers of

BAUSH
DURALUMIN

Blooms—Slabs—Billets—Sheets—Forgings

BAUSH CASTING METAL INGOTS
Aluminum Alloy of High Tensile Strength

Rolling Mill and Drop Forge Works
SPRINGFIELD, MASS.

Detroit Office:
1825 Dime Savings Bank Bldg.

This Cincinnati Shaper Won its Position by Reducing Costs

This Cincinnati Shaper is machining cone pulley brackets—two at a time—for the Webster & Perks Universal Grinder. Amount of stock removed from the two 9″ x 8″ surfaces is 1/8″. The boy operator in charge has no difficulty in making five set-ups per hour; turning out ten pieces in that time.

PRODUCTION was increased over that obtained by milling.

ACCURACY was not only maintained but improved.

HOURS were lessened with increased production.

CUTTER COSTS were reduced and arbor costs eliminated.

INVESTMENT required was a minimum releasing a much higher priced machine.

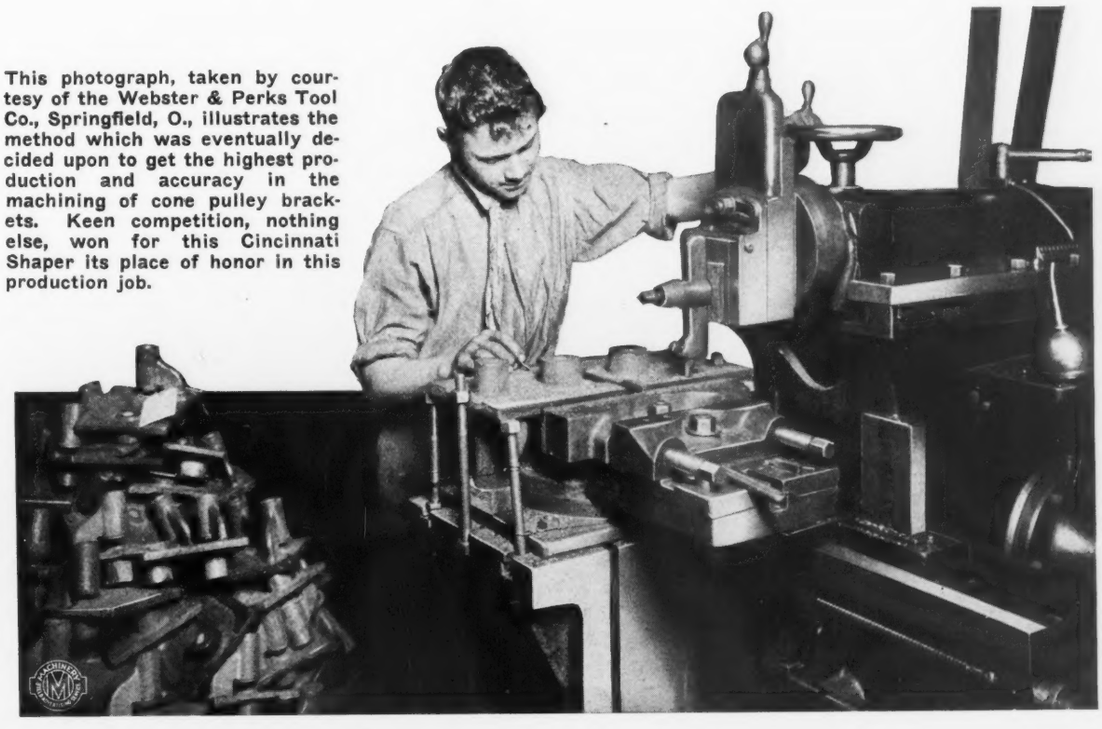
MAINTENANCE consists only of the cost of oil.

CONCLUSION—A saving in first cost and a saving in last cost.

The Cincinnati Shaper Company

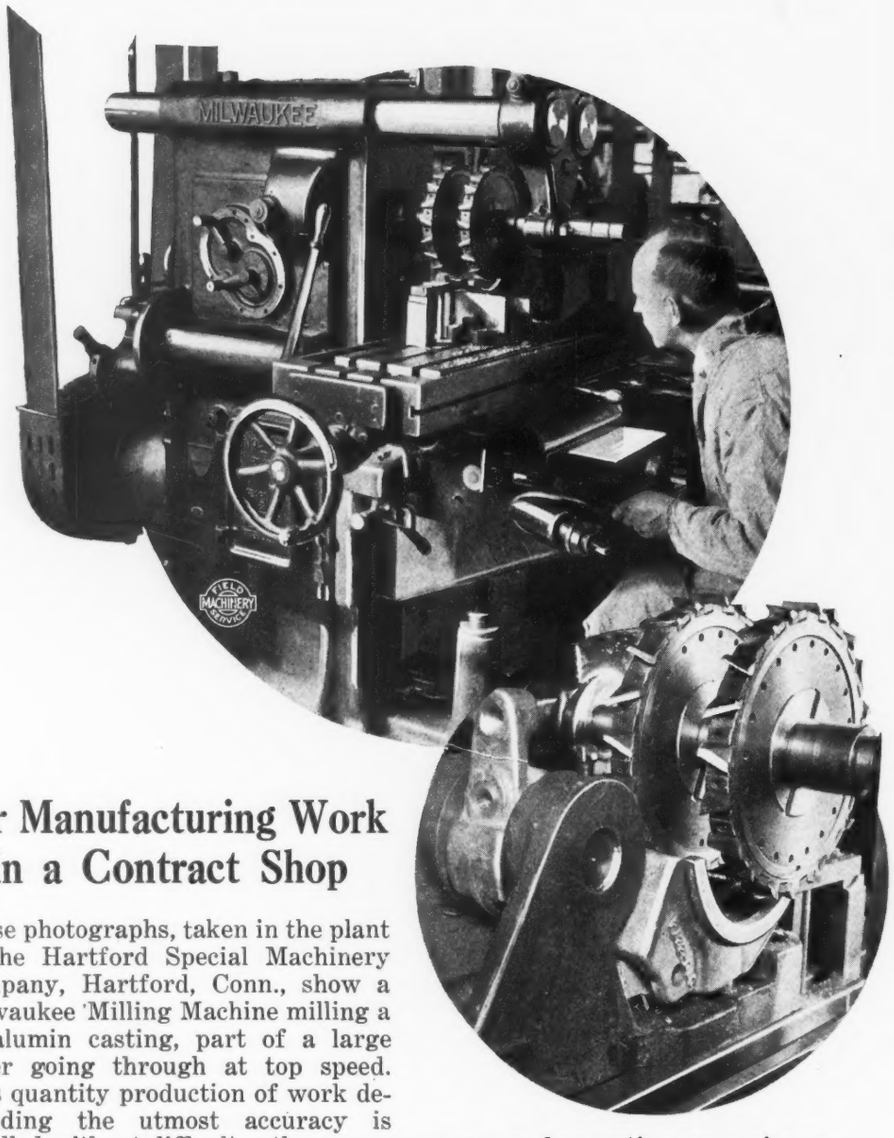
Manufacturers of standard machine tools for a quarter of a century

CINCINNATI, OHIO, U.S.A.



This photograph, taken by courtesy of the Webster & Perks Tool Co., Springfield, O., illustrates the method which was eventually decided upon to get the highest production and accuracy in the machining of cone pulley brackets. Keen competition, nothing else, won for this Cincinnati Shaper its place of honor in this production job.

MILWAUKEE MILLING MACHINES

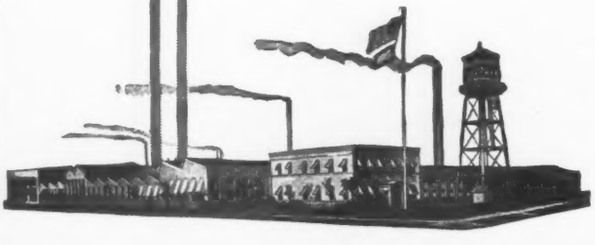


For Manufacturing Work in a Contract Shop

These photographs, taken in the plant of the Hartford Special Machinery Company, Hartford, Conn., show a Milwaukee Milling Machine milling a duralumin casting, part of a large order going through at top speed. This quantity production of work demanding the utmost accuracy is handled without difficulty; the range, accuracy and operating conveniences of Milwaukee Milling Machines make them particularly valuable equipment for manufacturing operations of this class.

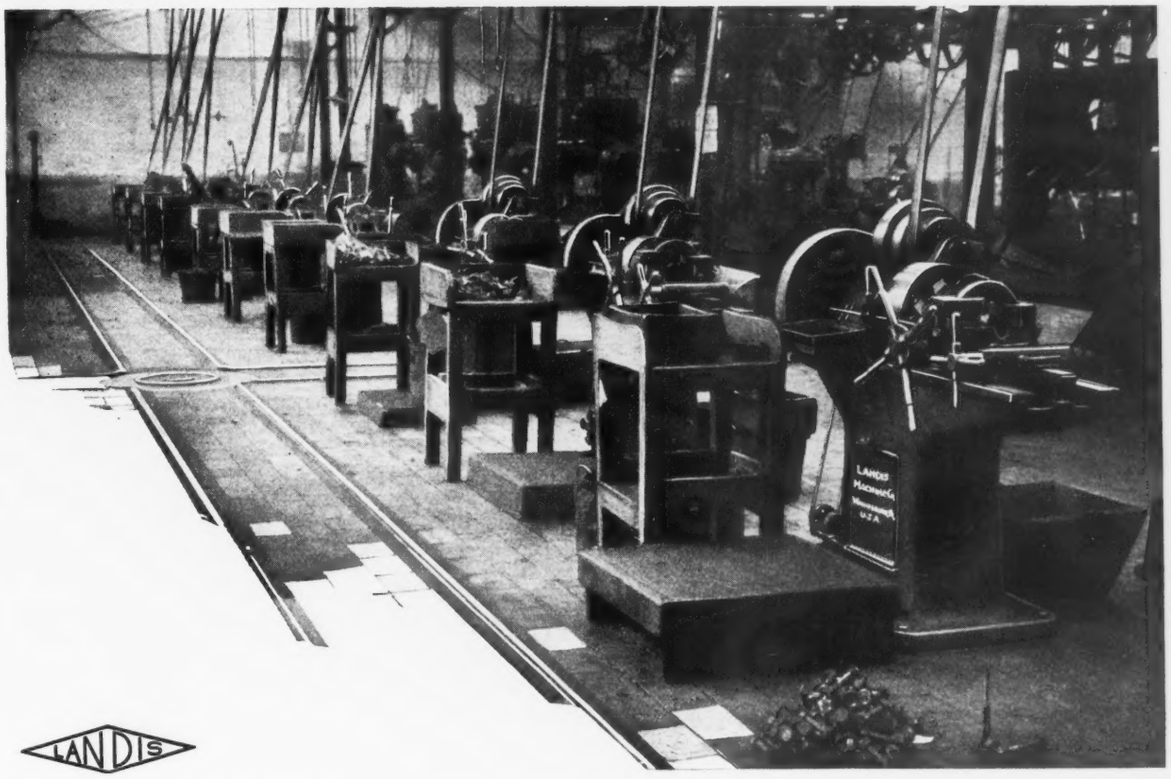
There are nine Milwaukee Milling Machines here giving uniformly satisfactory service on all the varied milling operations that come up on contract work.

If your work includes milling—any kind—get the details of these machines.



KEARNEY & TRECKER
CORPORATION
MILWAUKEE, WIS., U.S.A.

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LANDIS

At the Louviere (Belgium) Bolt Co. Works—Ten Landis Single Head Threading Machines in this Row

In addition to these ten 1½" Landis Single Head Threading Machines the Louviere Bolt Company has two more machines of the same size and one 2" Double Head machine, in another department. All of these machines are used for threading bolts; all are highly efficient and profitable; that they are entirely satisfactory to their owner is evident by the size of the installation.

If yours is a problem of cutting threads we'll be glad to put our engineering department at your command—no matter where you may be. Write us.

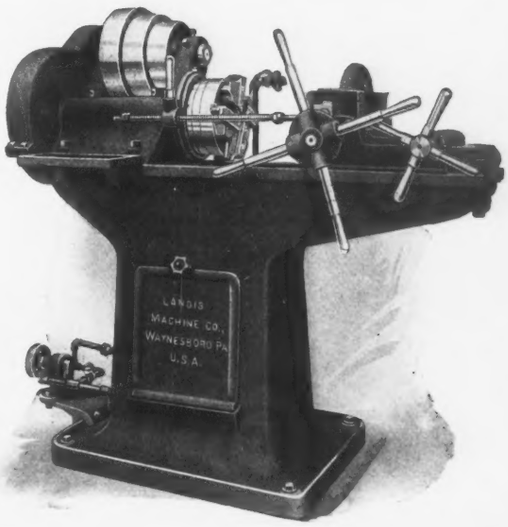
LANDIS MACHINE CO., Inc.

Waynesboro, Pa., U. S. A.

The Famous Landis Chaser



Landis Single Head Threading Machine



STEWART
Industrial Furnaces

The development of more than a quarter of a century of practical contact with every sort of industry. There's a Stewart Industrial Furnace for

Annealing	Lead Hardening
Billet Heating	Oil Tempering
Brass Melting	Pre-Heating
Carburizing	Rivet Heating
Cyanide Hardening	Rod End Heating
Drop Forging	Soft Metal Melting
Galvanizing	Spring Hardening
High Speed Steel Hardening	Tinning, Etc.

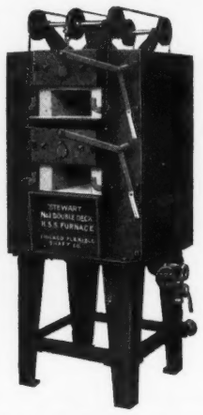
A very extensive line of standard sizes—the largest listed by any industrial furnace manufacturer. Also built in any special size to meet your requirements.

Exclusive United States Sales Agents for the Selas One Valve Control System

Chicago Flexible Shaft Company

1154 South Central Avenue, Chicago

350 Broadway, New York — 921 Granite Bldg., Rochester, N. Y. — 420 Wainwright Bldg., St. Louis — 608 Kerr Bldg., Detroit



Stewart Double Deck Hardening Furnace

Lower chamber for high heats necessary for high speed steel hardening—fitted with carbofrax hearth and supports. Also used for carbon steel hardening.

Upper chamber for preheating—heated by waste gases from lower chamber.

Five standard sizes.



Stewart No. 3 Forge

Dandy shop accessory for small blacksmithing and tool dressing.

Opening, 3½" x 8"; depth 10"

Floor space, 24" x 24"
Operates on gas only.
Shipping weight, 490 lbs.

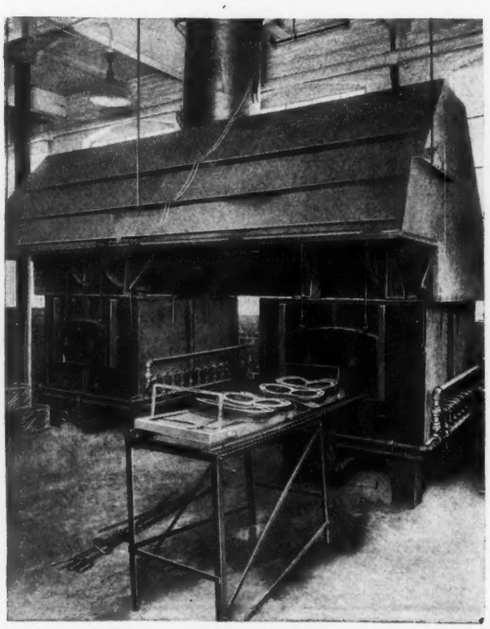
Stewart Accuracy Makes It Ideal Equipment for the Technical School

Stewart Triple Purpose Furnace installation in Pratt Institute, Brooklyn, N. Y.



Stewart Oven Furnaces

Used for Annealing by the Victor Mfg. & Gasket Company, Chicago, makers of copper-asbestos gaskets for automobiles, marine and stationary engines, etc.



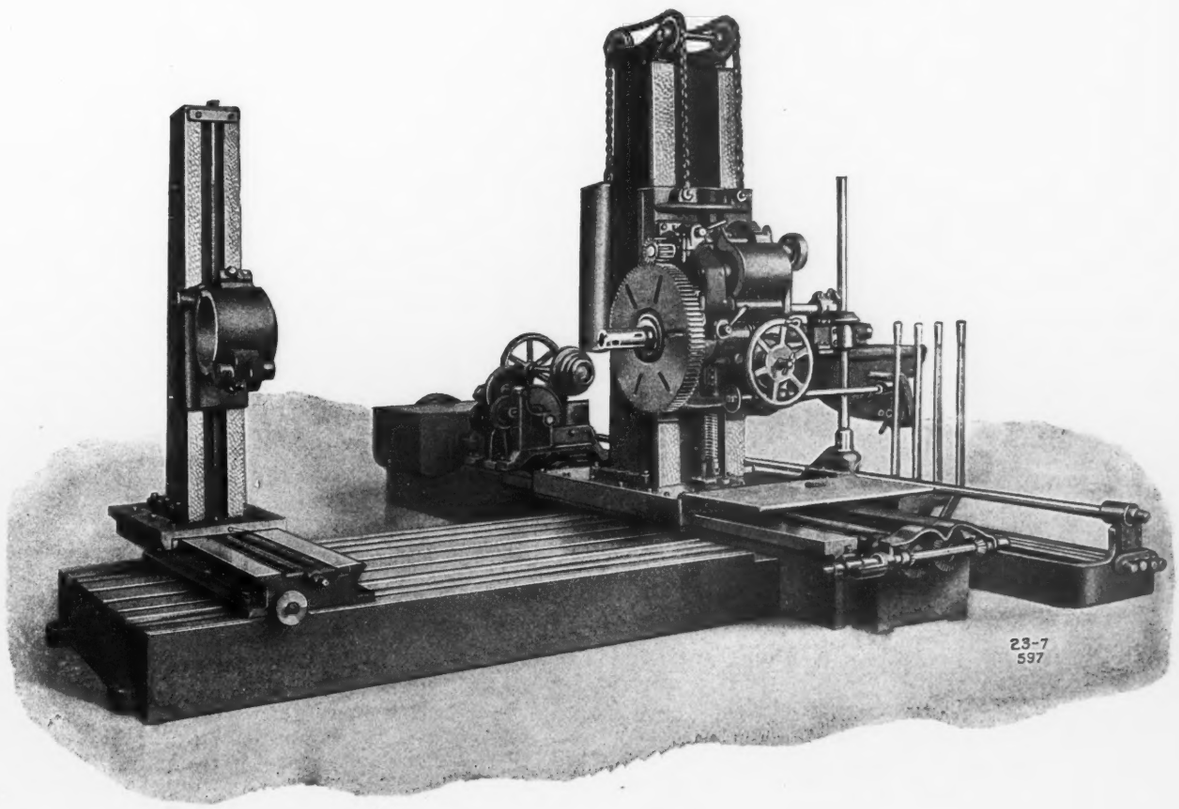
THE BEAMAN & SMITH

No. 2 Horizontal Milling, Drilling and Boring Machine

A serviceable model, simple, powerful and extremely accurate, particularly valuable where there is a demand for "production" on big parts.

Other models, vertical and horizontal, in single and multiple spindle types for all classes of work. A wide range of standard machines for regulation operations, special machines developed for unique and particular purposes.

Send for our catalogues; describe your special operations in detail. If we cannot recommend a regulation model we will devise a special machine that will help you do better work at lower cost.



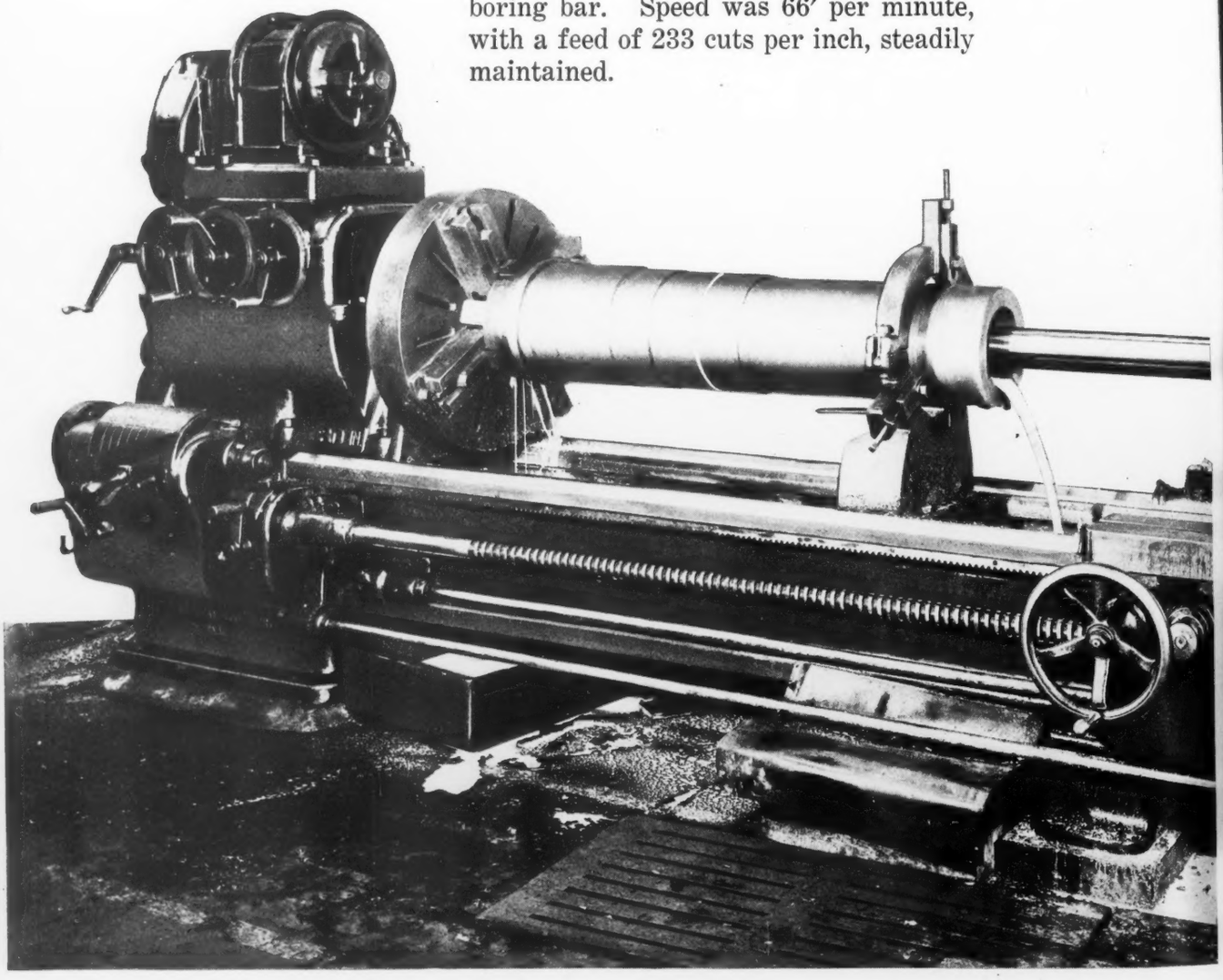
THE BEAMAN & SMITH COMPANY

PROVIDENCE RHODE ISLAND

LATHES AMERICAN PLANERS

Boring an 8" Hole Through Solid Steel on a 30" "American" Lathe—

An operation well calculated to test the power and workmanship of any machine. The piece is a forged bar of .40 carbon 3½% nickel steel, 60½" long; and no pilot hole was drilled before entering the boring bar. Speed was 66' per minute, with a feed of 233 cuts per inch, steadily maintained.



THE AMERICAN TOOL WORKS

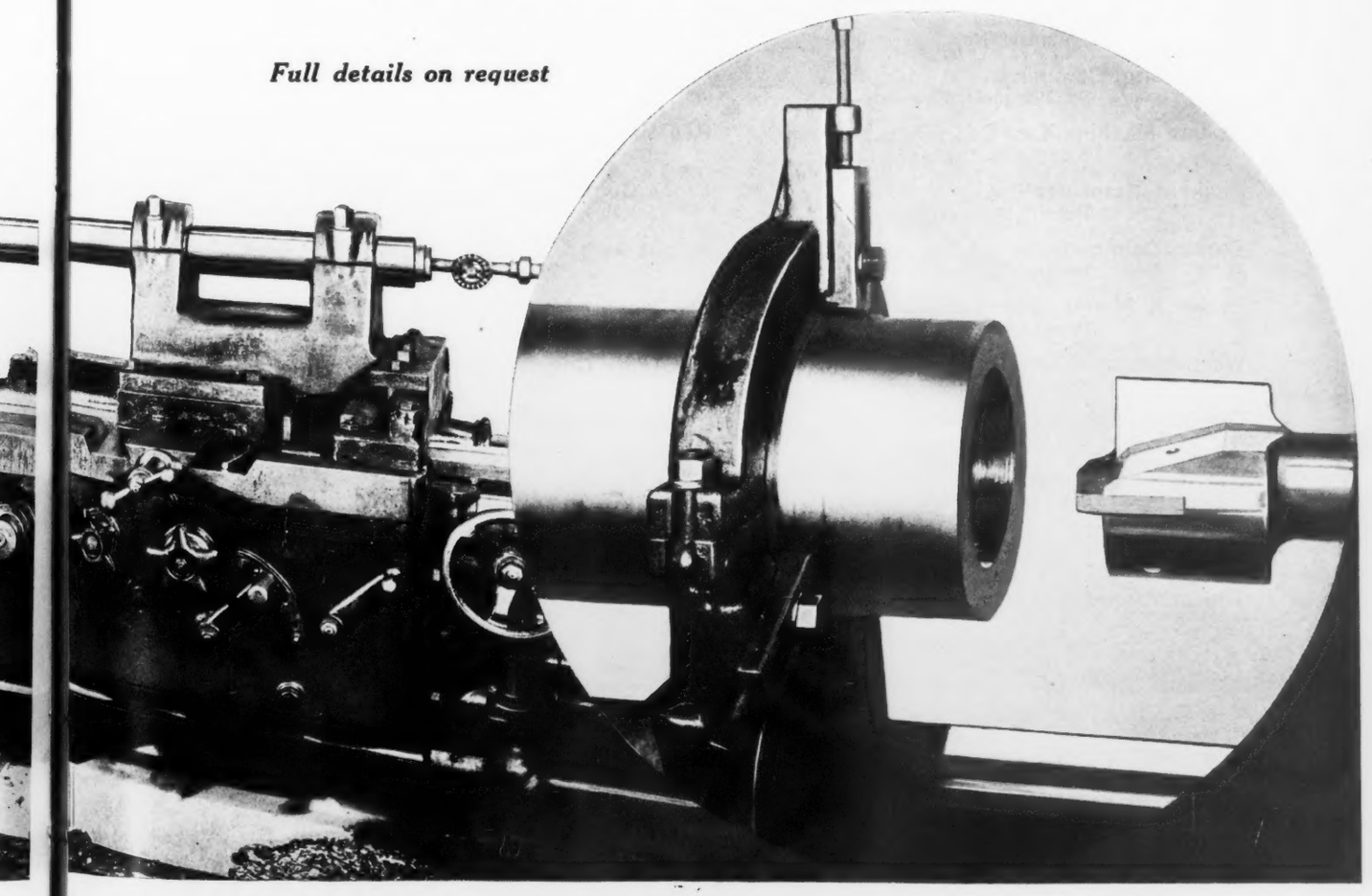
SHAPERS **AMERICAN** RADIALS

Stamina and Accuracy Are Built-in Features of "American" Lathes

Both toolroom and heavy duty machines are economical producers of high grade work. It took only 8 hours to perform the boring operation previously described; and seven more pieces were subsequently bored in the same time.

"American" Lathes are built for hard service, from the base up. Every part is well made of best materials, all bearings are carefully finished and tested for alignment, all controls and adjustments are simple and conveniently located; and the final inspection must find every part checking within limits of .001".

Full details on request



COMPANY, CINCINNATI, U. S. A.

The Hartness Screw

Prominent Users, Noted for

New Britain Machine Co.,
New Britain, Connecticut.

Winter Bros.,
Wrentham, Mass.

Hudson Motor Car Co.,
Detroit, Mich.

Cincinnati Milling Machine Co.,
Cincinnati, Ohio.

Russell, Burdsall & Ward Bolt & Nut Co.
Port Chester, New York.

Ford Motor Company,
Detroit, Michigan.

International Motor Co.,
Plainfield, New Jersey.

Spicer Mfg. Company,
So. Plainfield, New Jersey.

Bullard Machine Tool Co.,
Bridgeport, Connecticut.

Packard Motor Car Co.,
Detroit, Michigan.

Barber-Colman Co.,
Rockford, Illinois.

Brown & Sharpe Mfg. Co.,
Providence, R. I.

Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

Cincinnati Shaper Company,
Cincinnati, Ohio.

Studebaker Corporation,
Plant No. 5, Detroit, Michigan.

C. E. Johansson, Inc.,
Eskilstuna, Sweden.

The Lamson & Sessions Co.,
Cleveland, Ohio.

Grip Nut Company,
Chicago, Illinois.

W. L. Brubaker & Bros.,
Millersburg, Pa.

Hughes Tool Company,
Houston, Texas.

General Phonograph Mfg. Co.,
Elyria, Ohio.

Monarch Machine Tool Company,
Sidney, Ohio.

Western Clock Company,
La Salle, Illinois.

Cadillac Motor Car Co.,
Detroit, Michigan.

Oakland Motor Car Co.,
Pontiac, Michigan.

Reo Motor Car Company,
Lansing, Michigan.

Crane Company,
Chicago, Illinois.

Wright Aero Corporation,
Paterson, New Jersey.

The Hobart Mfg. Company,
Troy, Ohio.

The Buda Company,
Harvey, Illinois.

DeLaval Separator Company,
Poughkeepsie, New York.

Allis-Chalmers Co.,
Milwaukee, Wisconsin.

Pratt & Whitney,
Hartford, Conn.

Clemson Bros., Inc.,
Middletown, New York.

AGENTS

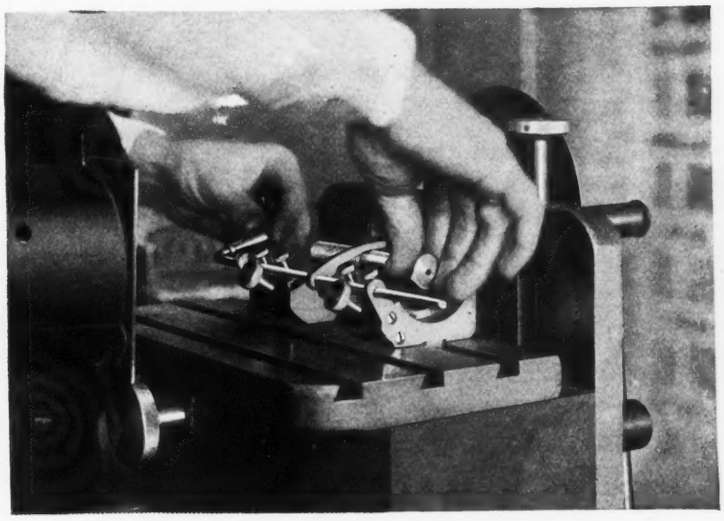
France, Spain and Belgum—F. Auberty & Co., 182 Rue Lafayette, Paris. Holland — Splethoff, Beeuwkes & Co., Leuvehaven, wz, 159 Rotterdam.

Jones & Lamson

SPRINGFIELD, VERMONT, U. S. A.

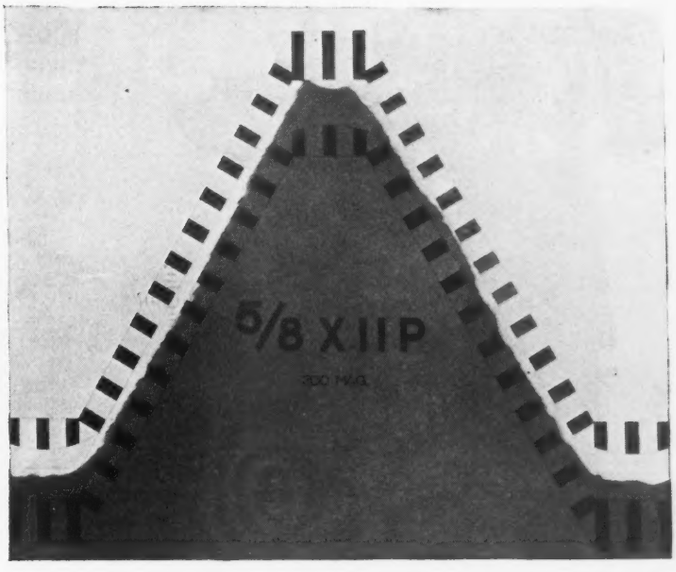
Thread Comparator

the Accuracy of their Product



The thread to be visually gaged is placed here. Its enlarged shadow on the screen can be unerringly checked at the rate of approximately 500 screws per hour.

Explanation of Chart. The diagram on the chart (the dotted section) marks the limit of tolerance. The shaded portion is the thread enlarged.



Machine Company

9-10 Water Lane, Queen Victoria St., London, E.C., Eng.

503 Market Street, San Francisco, California

AGENTS

Japan, Korea, etc., Mitsui & Co., Ltd., Tokio. Australasia—McPherson's Pty., Ltd., 554 Collins St., Melbourne. Sweden—A. Boll. Oscar Lindbom, Stockholm—Post Box 420.

Right Tin the Lead

IN ONE MINUTE

6⅔ Spud Nuts were Tapped with a 2" Diameter Thread.

Twenty-three Electrical Conduit Ends were Threaded with a ¾" Diameter Thread on a

Geometric Threading Machine





One machine carries a Geometric Collapsing Tap, and the other machine a Geometric Self-Opening Die Head. For handling the threading of the Conduit Ends, a special attachment has been provided by the people who operate the machine.

Have you thought to equip your shop with Geometrics, too? Whoever puts a Geometric Threading Machine in a Machine Shop, or equips a Screw Machine with a Geometric Screw Cutting Tool, does a service to industry.

Learn through the Catalog the Variety and Qualifications of Geometric Threading Machines and Tools.

Consult us on any Thread Cutting Proposition, and you shall have the advice of men long experienced in Screw Thread Cutting, without the annoyance of an attempt to force a sale. Our time is yours. Your time is your own.

THE GEOMETRIC TOOL CO., New Haven, Conn.

CHICAGO OFFICE: 627 WEST WASHINGTON BOULEVARD

General Distributors for Michigan, The Charles A. Strelinger Co., Detroit

WESTERN SALES AGENTS: The Tool Equipment Co., San Francisco. AGENCIES: Blacknan-Hill-McKee Machinery Co., St. Louis, Mo.; Hill, Clarke & Co., Inc., Boston, Mass.; Kemp Machinery Co., Baltimore, Md.; The National Supply Co., Toledo, O.; The W. M. Pattison Supply Co., Cleveland, O.; Root, Neal & Co., Buffalo, N. Y.; F. E. Satterlee Co., Minneapolis, Minn.; Somers, Fitler & Todd Co., Pittsburgh, Pa.; Vandyck Churchill Co., New York and Philadelphia; Vonnegut Machinery Co., Indianapolis, Ind.; The C. H. Wood Co., Syracuse, N. Y.; The Western Iron Stores Co., Milwaukee, Wis. CANADA: The A. R. Williams Machinery Co., Ltd., Toronto, Vancouver, (B. C.), Halifax, (N. S.), and St. John, (N. B.); Williams & Wilson, Ltd., Montreal. FOREIGN: Allied Machinery Co. of America, France, Italy, Switzerland, Spain, Portugal; Andrews & George, Tokyo, Japan; Bevan & Edwards, Melbourne; Buck & Hickman, Ltd., London, Birmingham, Manchester, Glasgow; Etablissements Hortsmann, Paris; V. Lowener, Copenhagen, Christiania, Stockholm; Trading Company, R. S. Stokvis & Zonen, Rotterdam, Holland, and Brussels, Belgium; White & Rae, Sydney.

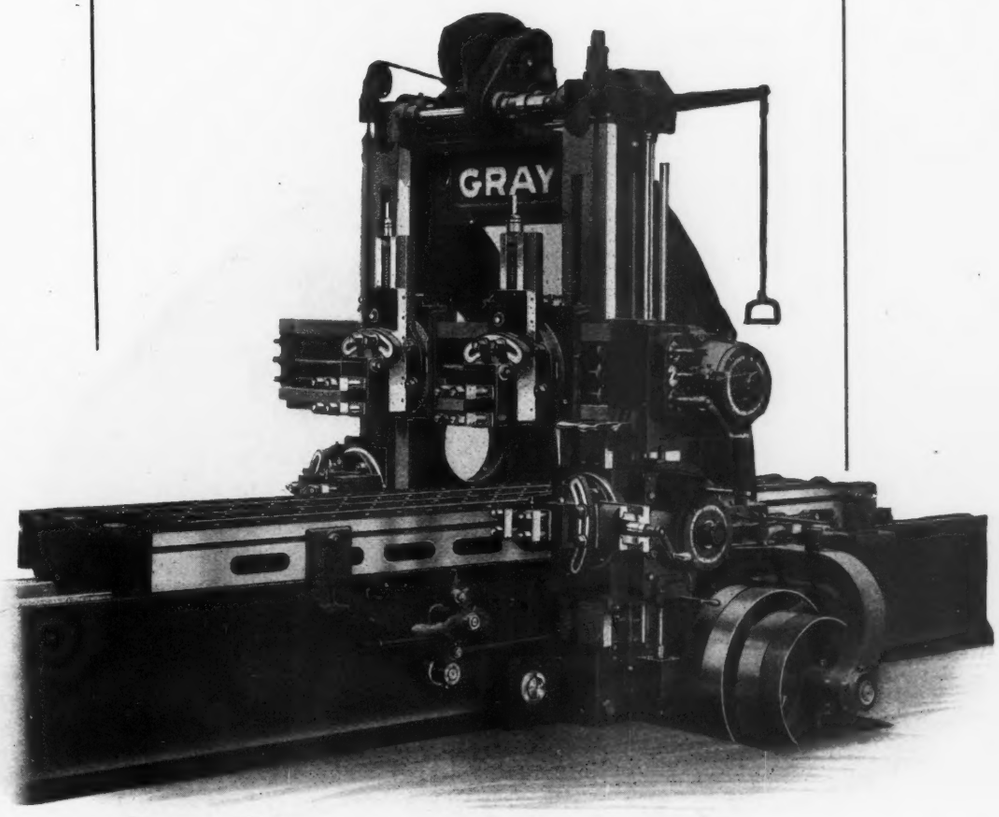
GRAY MAXIMUM SERVICE PLANERS

Exclusive Features:

1. **"Gray-Geared"** for power and enduring smoothness of motion. Introducing a new type of gearing. (Pat. applied for)
2. **Gray "Cantslip" Feed.** It's positive and instantly set. Simple as turning a door knob. (Patented)
3. **Gray "Single-Shift"** rapid power traverse for side heads as well as rail heads. (Patented)
4. **Gray "Rail-Setter."** You can set the rail without moving from the operating position. (Patented)
5. **Gray "Rail-Lock."** A single crank on the operator's end of the rail locks the rail to the inside of the housings, shortening the length subject to torsional strain. (Pat. applied for)
6. **Gray Double-Length Bed.** Table never overhangs.
7. **Gray Center-Wall Box Section Table.** The uninterrupted vertical center wall prevents springing.
8. **Gray Constant Pressure Forced Lubrication for V's.** Every point gets an equal amount of oil. (Pat. applied for)
9. **Gray Forced Lubrication** floods driving shaft bearings with filtered oil.
10. **Gray Drive Gears** run in a bath of oil.
11. **Gray Centralized Lubrication** on rail, side heads, and top brace. Eliminates a multitude of oil cups.
12. **Gray Centralized Control.** Brings complete control of the planer to central point, saving time and energy.

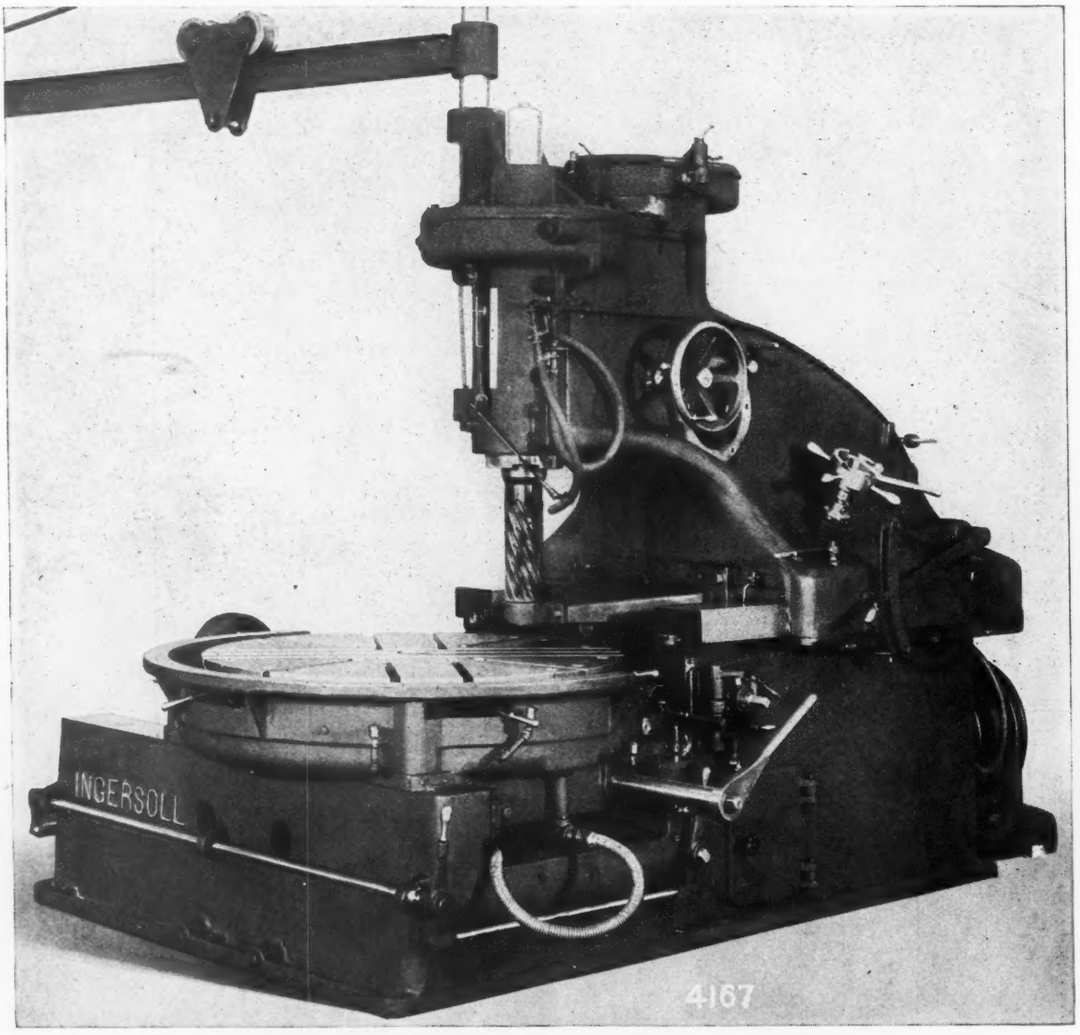
THE G. A. GRAY CO.

CINCINNATI, OHIO



INGERSOLL

Adjustable Rotary Milling Machine for Profile Milling, Face Milling and Die Sinking



The Ingersoll Adjustable Rotary Milling Machine is a tool developed for shops having a wide range of work. It can be used to advantage for profile milling, die sinking or face milling. It is invaluable in railroad shops for profiling locomotive rods and straps, milling out piston and strap ends of main rods and milling slots from the solid, etc. An exceptionally large combination of movements can be obtained from the head, housing, table and saddle of this machine.

The table rotates by hand or power on a saddle which in turn is mounted on wide ways of the bed and can be fed in either direction. The table and saddle can be locked together so that they form virtually a single casting.

The spindle is mounted in a housing which can be fed toward or away from the line of the table travel. The spindle has a vertical adjustment of 21 inches and is fitted with boring and drilling feed.

The control levers are all located so that the operator can reach them while watching his work. The jib crane on the machine is standard equipment and is of great value in setting heavy castings or forgings.

The Ingersoll Milling Machine Co.

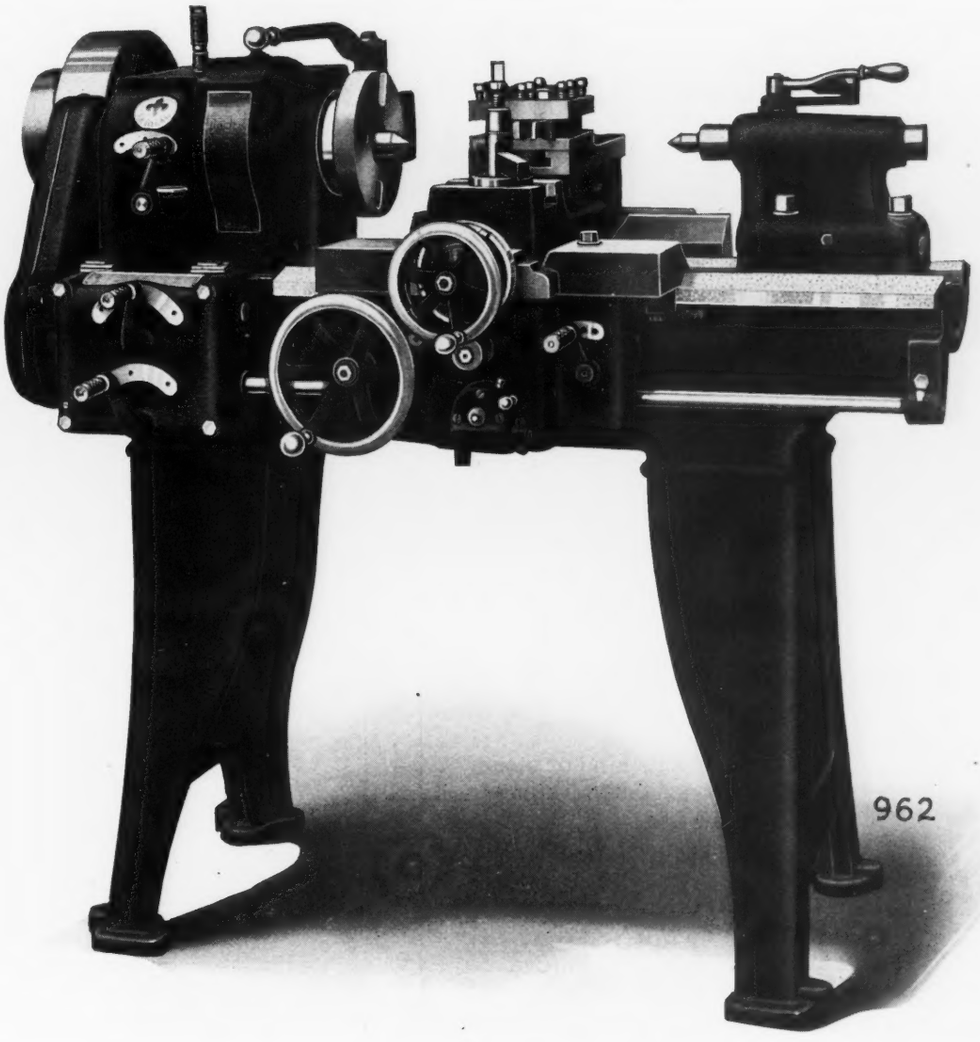
Milling Machines and Their Equipment

Detroit: David Whitney Bldg. ROCKFORD, ILL. 50 Church Street, New York

Introducing

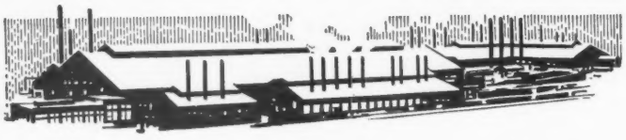
The 11-Inch Heavy Duty Rapid Production Lathe

A new LeBlond Heavy Duty Lathe of small swing and high production capacity for the manufacture of small parts in quantity —retaining all regular LeBlond Heavy Duty features making for increased production per *unit of labor*. Can be supplied as a plain turning lathe or with automatic back facing attachment for combining turning and facing cuts. We will gladly submit production estimates.



The R.K. Le Blond Machine Tool Co.
Cincinnati. Ohio.

COLONIAL TOOL STEELS



The Colonial Mill at Monaca, Pa.

Jobs that are done well with *Colonial*

An interesting example:—for cutting tempered steel blades "Colonial No. 7 stands the job best."

THE BENEDICT MFG. CO.
EAST SYRACUSE, N. Y., U. S. A.

Colonial Steel Co.,
177 Hudson St.,
New York City.

Gentlemen:—

We are sending you today steel blades, and also two handles, which we are cutting up here with your Colonial No. 7 Cut Die Steel.

Mr. Peck says he has tried every kind of steel for these two jobs and finds that the Colonial No. 7 is the only Die which will stand to cut the standard hardened blade from a coil 7/8" wide.

We cut 140 gross of blades and then grind the dies and repeat the operation. The dies are made in four separate pieces, to allow for the grooves which come on the cutting edge. These can be ground out by flexible shaft grinding, and the center recess shortened up. This makes the blades always the same length. The two outside pieces are Colonial No. 7, and the center pieces are machinery steel.

The handles are cut with the same kind of made up dies. The hot rolled scale on the handles is of course very hard on the dies.

No. 7 stands the job the best of any steel on the market anywhere near the price.

Yours very truly,

BENEDICT MFG. CO.

LIST OF TOOLS
and Grades of Colonial Steel adapted for their use

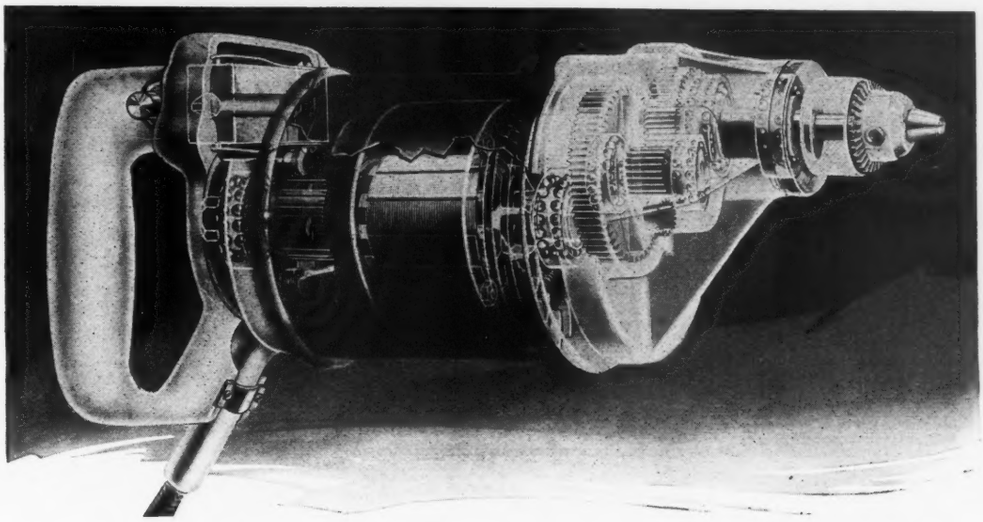
Name of Tool	Grades of Steel
Arbors	Red Star
Augers, Wood & Bits	Red Star
Axe	Red Star
Ball Bearings	Superior
Bits, Channeling Machine	Red Star
Bits, Coal Mining	Anchor
Bits, Tong	Red Star
Bits, Well Stone Drilling	Standard Well Bit
Bush Hammer, Stone Tools	Red Star Sheets
Bunter, Heading	Red Star
Broaches, Machine	No. 7, High Speed
Bushings	Red Star
Center Punches	Red Star
Center, Lathe (see L)	Red Star
Chasers, Threading	H. S., No. 7, No. 14
Chain, Pipe, Links	Vanadium, Type A
Chisels, Pneumatic	No. 7
Chisels, Hand	Red Star
Chisels, Stone Cutters	Red Star
Chisels, Wood Working	Red Star
Cupping Tools	Red Star
Caulking Tools	Red Star
Claw Bars	Red Star
Creasers, Hot	H. S., No. 7 E
Counterbores	H. S., No. 14
Counterbores, Solid, Interchangeable	H. S., No. 7, No. 14
Collets, Bit Brace	Red Star
Collets, Spring	Red Star
Cutters, Fine Finishing	No. 5
Cutter, Pipe	H. S., No. 14
Cutters, Flue	No. 7, High Speed
Cutters, Flue Hole	No. 7
Cutters, Nail	High Speed
Cutters, Corn Stalk	Alto Sheets
Cutters, File	High Speed
Cutters, Milling, Plain	High Speed
Cutters, Form	High Speed
Cutters, Inserted Blade	High Speed
Cutters, Profile	High Speed
Cutters, Metal Slitting	High Speed
Cutters, Screw Slotting	No. 5
Cutters, Wood Forming	High Speed, No. 5
Cutting off Tools	High Speed
Dies, Bolt Threading	H. S., No. 7, No. 14
Dies, Blanking	H. S., No. 7, No. 14
Dies, Forming & Bending	No. 7, No. 14
Dies, Sub-Press	No. 7, No. 14
Dies, Drawing	H. S., No. 7, No. 14
Dies, Cartridge Shell	High Speed, No. 7
Dies, Hammer Dies, Power	Red Star
Flat Jack Jewelers' Dies	High Speed No. 7
Dies, Drop Forging	Red Star, Alto
Dies, Nail	High Speed
Dies, for Paper	H. S., No. 14
Dies, Pipe Threading	H. S., No. 7, No. 14
Dies, Solid & Adjustable Threading	H. S., No. 7, No. 14
Dies, Glove	No. 7, No. 14
Dies, Rivet	No. 7, Red Star
Dies, Shoe Knife	Red Star
Dies, Spring Screw, Threading	H. S., No. 7, No. 14
Dies, Solid Bolt	No. 7, No. 14
Dies, Adjustable, Round	
Dies, Split Threading	H. S., No. 7, No. 14
Dies, Spoon, Silver	No. 14
Dies, Silversmith	No. 7
Dies, Domino Screw Cold Heading	No. 7, Red Star
Dies, Cold Heading	No. 7, Red Star
Dies, Hot Heading	H. S. or No. 35
Dies, Wire Drawing	No. 14
Dies, Plates	No. 7, No. 14
Digging Bars	Red Star
Drills for Boring	Red Star
Drills, Tool Steel	H. S., Superior
Drills for Stone	Red Star
Drills, Twist	High Speed
Drills, Flat	High Speed
Engraver Tools	No. 14
Furnace Bars	Anchor
Flatters, Blacksmiths	Red Star
Fullers, Blacksmiths	Red Star
Forming Tools for Metals	H. S., No. 5, No. 14
Flange Tire Forming Tools	High Speed
Gear Cutters	High Speed
Gauges	Oil Hardening No. 6
Grip Dies for Rivets, Hot	No. 35
Hatchets	Red Star
Hammers, Blacksmiths	Red Star
Hammers for Crushing Machines	Red Star
Hammers, Pneumatic	No. 7
Hammers, Nail Machines	No. 7
Hammers, Riveting Pneumatic	No. 7
Hobs, Gear	H. S., No. 7, No. 14
Header Dies, Cold	No. 7, Red Star
Header Dies, Hot	No. 35
Jaw Chuck	Anchor
Jaw Vise	Anchor
Keys for Drop Hammers	Red Star
Knives, Pocket	Red Star Sheets
Knives, Carver	Red Star Sheets
Knives, Butcher	Red Star Sheets
Knives, Cleavers	Red Star Sheets
Knives, Back Spring	Alto Sheets
Knives, Heel Forming Shoe	No. 14
Knives, Shoe Makers	Red Star Sheets
Knives, Shoe Sole	Red Star
Knives, Surgical	No. 14
Knives, Table	Alto Sheets
Knives, Potato	Alto Sheets
Knives, Corn Knife	Alto Sheets
Knives, Drawing	No. 14, Red Star
Knives, Hog	No. 14
Knives, Machine	H. S., Red Star
Knives, Paper	H. S., or No. 14
Knives, Shear	No. 7, Red Star
Knives, Wood Working	H. S., Red Star
Knurling Tools	No. 7, No. 14
Lathe Centers, Dead	Red Star
Lathe Center, Live	Red Star
Lathe Tools for Metal Turning	High Speed
Lathe Tools for Woodworking	High Speed
Liners for Brick Dies	Imperial
Letter Stamps, Hand	No. 7, No. 14
Letter Stamps, Roll	No. 7, No. 14
Mandrels	Red Star
Mills, End	High Speed
Mills, Hollow	High Speed
Mills, Shell End	High Speed
Piercers, Hot	High Speed
Pick Steel	Alto
Pinion Bars	Red Star
Pins, Drift	Red Star
Pinch Bars	Red Star
Planer for Metal Tools	High Speed
Planer for Stone	High Speed
Planer for Wood	Red Star
Point Steel for Stone Cutters	Red Star
Punches, Cartridge Shell	No. 7
Punches, Hand—Hot or Cold Work	H. S., or No. 7
Punches, Drawing	No. 7, No. 14
Plug Gauges	No. 6, Oil Hard'ng
Pneumatic Tools	No. 7E or F
Reins, Tong	Red Star
Rods, Piston	Red Star
Reamers, Hand, Solid	H. S., or No. 5
Reamers, Shell	High Speed
Reamers, Taper	High Speed
Reamers, Rose, Chucking	High Speed
Reamers, Locomotive, Taper	No. 14, H. S.
Reamers, Bridge	High Speed
Reamers, Expansion, Hand	High Speed
Reamers, Drill & Center	No. 5
Rolls, Flue Expanding	No. 7
Ring Gauges	No. 6, Oil Hard'ng
Rivet Sets	No. 7, Red Star
Shear Blades—Hot Work	H. S., No. 7
Shear Blades—Cold Work	No. 7, Red Star
Saws, Circular Metal	H. S., Nikro
Saws, Circular Wood	Nikro
Scrapers for Scraping Machine Parts	No. 5
Scrapers, Tube	Red Star
Screw Drivers	Red Star
Set—Rivet	No. 7, Red Star
Sets—Button	No. 7, Red Star
Sets—Nail	Red Star
Splining Tool	High Speed
Shaper Tool	High Speed
Stamping Tools	No. 7, No. 14
Sledges, Blacksmith & Stone	Red Star
Snaps, Rivet	No. 7, Red Star
Springs	Red Star
Swages, Blacksmith	Red Star
Swaging Metal	No. 7
Taps, Tapper	No. 14, Red Star
Taps, Hand	Red Star Tap, Extra No. 14
Taps, Machine	H. S., Red Star
Taps, Automatic Machine Screw	High Speed, No. 7
Taps, Staybolt	No. 14
Taps, Pipe Taps	Red Star
Taps, Pipe Tap Chasers	High Speed, No. 7
Tire Turning	High Speed
Tool Holder Bits	High Speed
Wedge, Stone	Red Star
Wedges	Red Star
Wrenches, Track	Red Star

Full instructions for hardening and tempering all Colonial Tool Steels will be found in the *Colonial Heat Treating Book*.
MAILED FREE.

Colonial Steel Company

PITTSBURGH BOSTON NEW HAVEN NEW YORK CLEVELAND
DETROIT CHICAGO ST. LOUIS

SKF



Self-Aligning Ball Bearings

Make Portable Tools Compact and Reliable

MOTOR and spindle bearings in portable tools must be light and compact, yet able to withstand the high speeds, heavy loads, repeated shocks and continuous vibration to which most portable tools are subjected in service.

Regardless of the position in which they may operate, **SKF** marked self-aligning ball bearings in oil-tight housings permit the tool to be tilted in any direction without loss of oil from the bearings.

Self-aligning ball bearings properly installed show no appreciable wear; motor armatures, therefore, maintain their position, and chattering and end-shake due to play in armature and spindle bearings cannot occur. Gears are kept in proper mesh and any misalignment that occurs is automatically compensated for without strain in the bearings.

Our engineering department will be glad to make recommendations for your particular requirements.

THE SKAYEF BALL BEARING COMPANY

Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

770



Normal View *Deflected View*

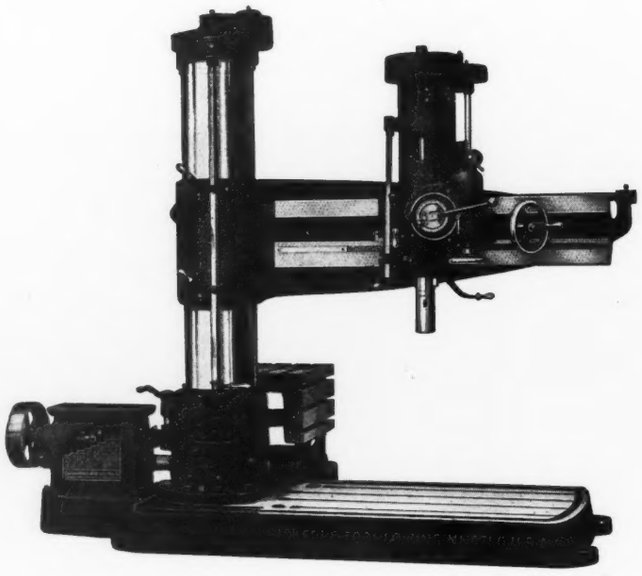
BALL BEARINGS

The Highest Expression of the Bearing Principle

THE CINCINNATI BICKFORD

Plain Radial Drills Have Exclusive Features that Reduce Drilling Costs

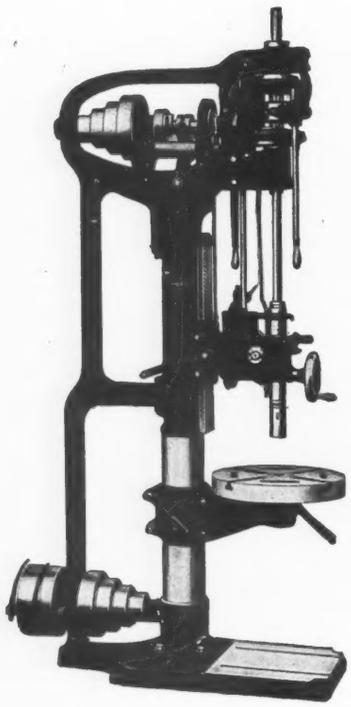
We've eliminated 4 operations and shortened 15 of the 22 ordinarily required to drill a hole with our big, powerful 4, 5, and 6 foot Radial Drilling Machines. All this by means of a few simple, carefully designed features—the result of 49 years' experience in anticipating and satisfying the needs of drilling machine users. Let us tell you more about them.



The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

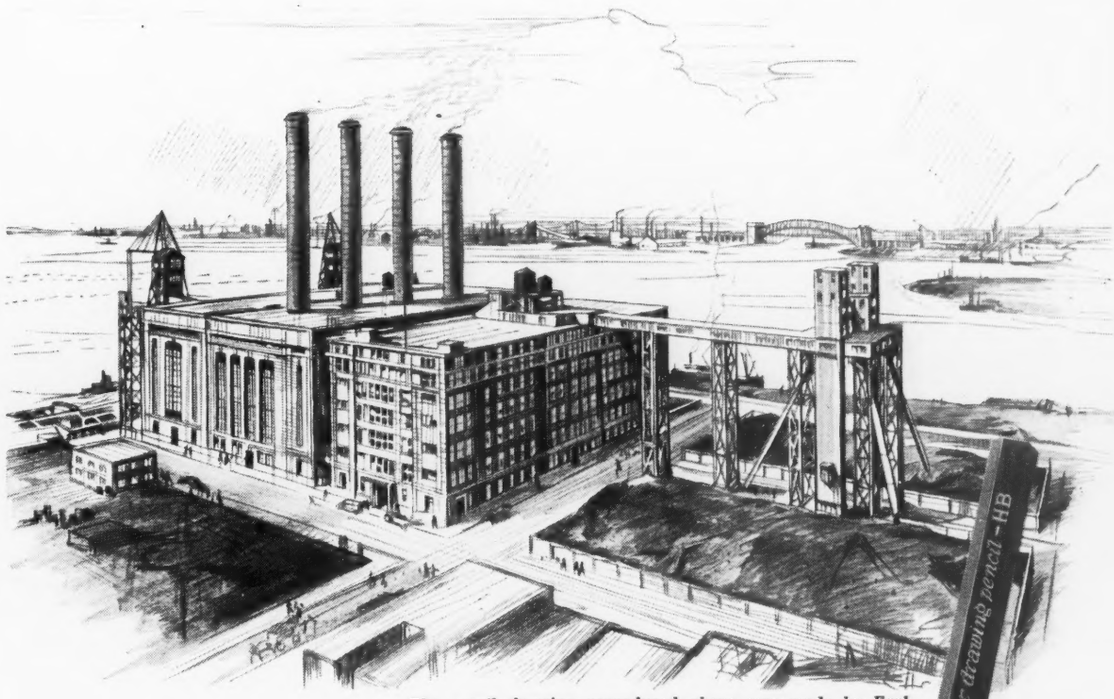
Founded 1874



THE CINCINNATI

21-Inch Sliding Head Upright Drilling Machine

The rugged simplicity and centralized control, which are outstanding features of this heavy pattern machine, permit it to be used to advantage in a far wider field than is usually open to machines of its class. In common with all our Drilling Machines it affords a sufficient variety in drive fittings to meet every condition and class of service which may arise. Catalog describes the whole line.



The pencil drawing reproduced above was made by Earl Horter with Dixon's Eldorado—"the master drawing pencil."

The Largest Steam Power Plant in the United States

The new Hell Gate Power Station of the United Electric Light and Power Company (shown above) was designed by Thomas E. Murray, Inc., of New York City.

When completed, it will be the largest steam power plant in the United States with an ultimate capacity of 300,000 K. W.

The plans for this plant, as for so many others of conspicuous size and importance, were prepared with Eldorado pencils.



DIXON'S ELDORADO

"the master drawing pencil"

SAMPLE OFFER

Write for full-length free samples of *"The master drawing pencil"* and of Dixon's "BEST" Colored Pencils. In their field, the "BEST" Colored Pencils hold the same position of supremacy as Dixon's Eldorado.

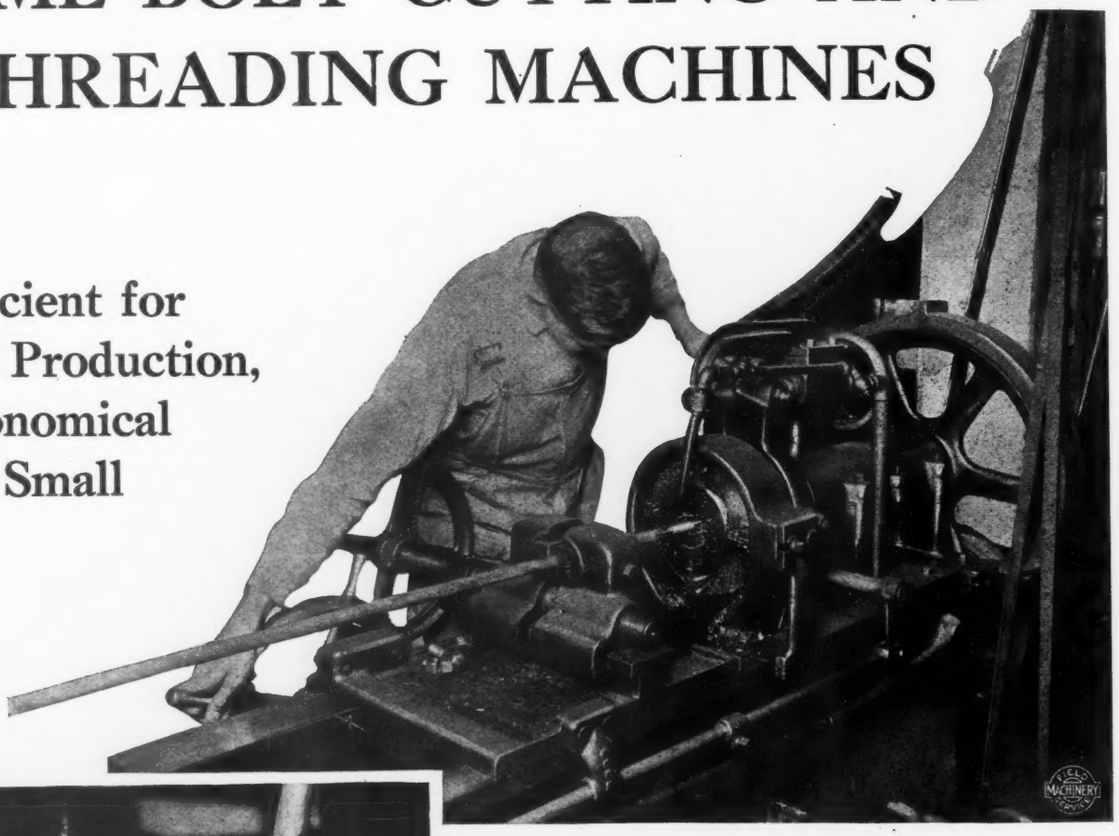
Dixon's Eldorado is made in 17 leads—for all pencil work.

JOSEPH DIXON CRUCIBLE COMPANY

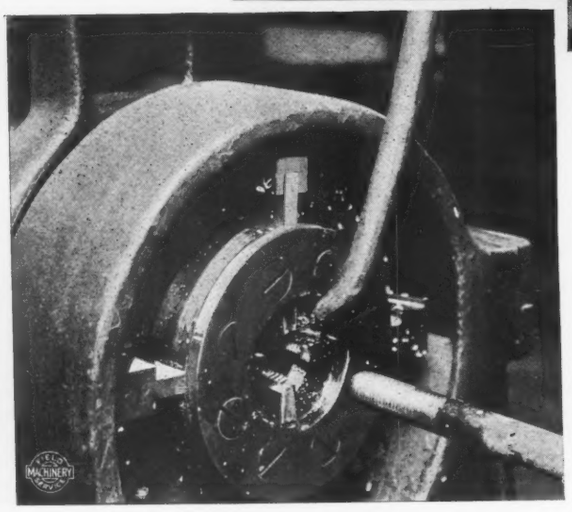
Pencil Dept. 74-J Jersey City, New Jersey

Canadian Distributors: A. R. MacDougall & Co., Ltd., Toronto

ACME BOLT CUTTING AND THREADING MACHINES



Efficient for Big Production, Economical for Small



Photographs shown through courtesy of Herman Behr & Company, Brooklyn, N. Y. A 2″ Single Head Acme Bolt Cutter installed four years ago, cutting thread on end of a ¾″ steel rod. By changing dies this Acme is used for bolt and pipe threading, accommodating any work up to 2″ diameter.

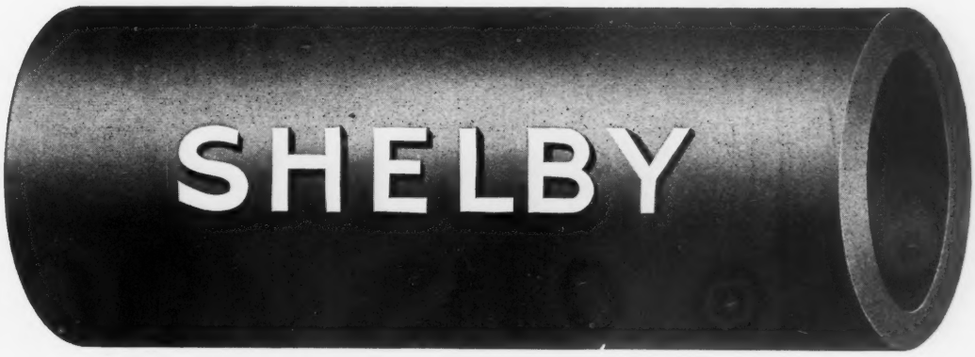
Acme Bolt Cutters and Threaders are designed for strength, durability and ease of operation. They are efficient for large production and economical for small—two characteristics which have won many orders for this equipment.

Another Acme feature is the lubricating method, insuring a generous stream of coolant to the dies at all spindle speeds. The Acme Die Head is simple, lasting and cheap to maintain. All wearing parts are of hardened tool steel ground to size.

We've printed a copy of our new catalog for you.

THE ACME MACHINERY COMPANY, Cleveland, Ohio

Foreign Agents: Burton, Griffiths & Co., Ltd., London; Glaenzer & Perreaud, Paris, France



Use of Mechanical Tubing in Place of Solid Stock or Forgings

IT is the natural desire of every good manager to avoid waste in every possible direction, and one of the principal evidences of this is seen in the tendency to select materials from which there shall be minimum waste in the processes of manufacture. There are instances where the use of solid stock requires the removal of more material than the total amount left in the finished article.

The hollow construction and high standards of accuracy of Seamless Steel Tubing often reduce many regular manufacturing operations to light, or finishing, operations, while the diversified range of sizes, numerous wall thicknesses and shapes, make it possible to handle more economically many so-called "special jobs" by using tubing instead of solid stock or forgings.

Our Booklet—"SHELBY" Seamless Steel Tubes and Their Making—will surely be found useful. Shall we send you a copy?

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

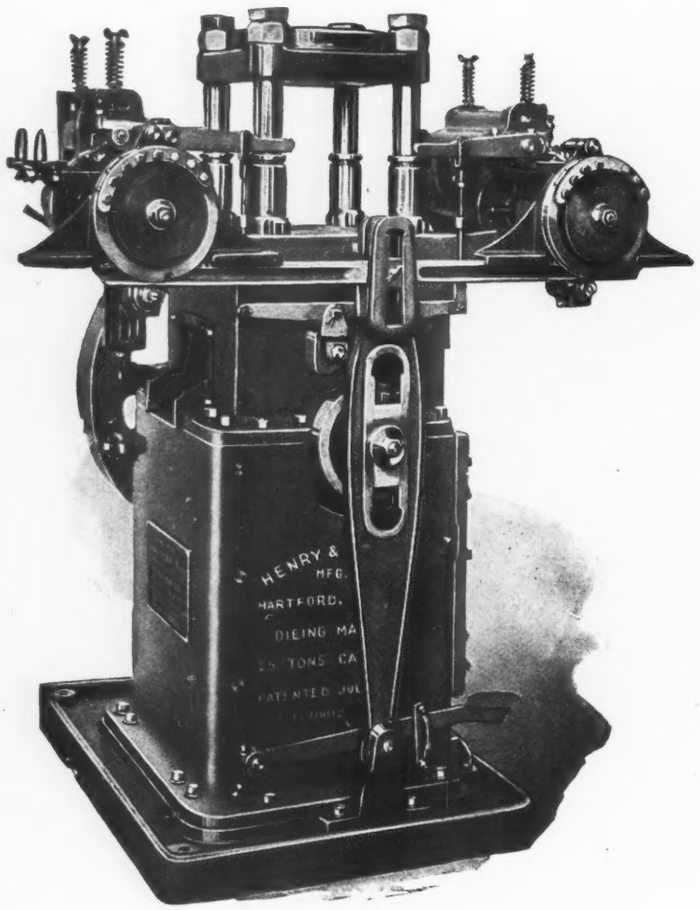
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In 25 and 50 Ton Capacities

Wright Dieing Machines

Patented July 2nd, 1918.
Other Patents Pending.

The Wright Dieing Machine has pulled punch press work out of its rut and put it on a genuine manufacturing basis. The Wright is daily slashing costs, tripling output, revolutionizing manufacturing procedure and giving an entirely new meaning to production efficiency.

Punch presses have been in common use since the time the artisan first employed sheet metal as a basis of manufacture. For the past hundred years there had been but little change in the type or construction of presses for the use of blanking, forming, drawing, embossing, etc., of sheet metal until the Wright Dieing Machine appeared. The Wright has helped every user to turn over a new leaf—to increase production from 20 to 50 per cent.

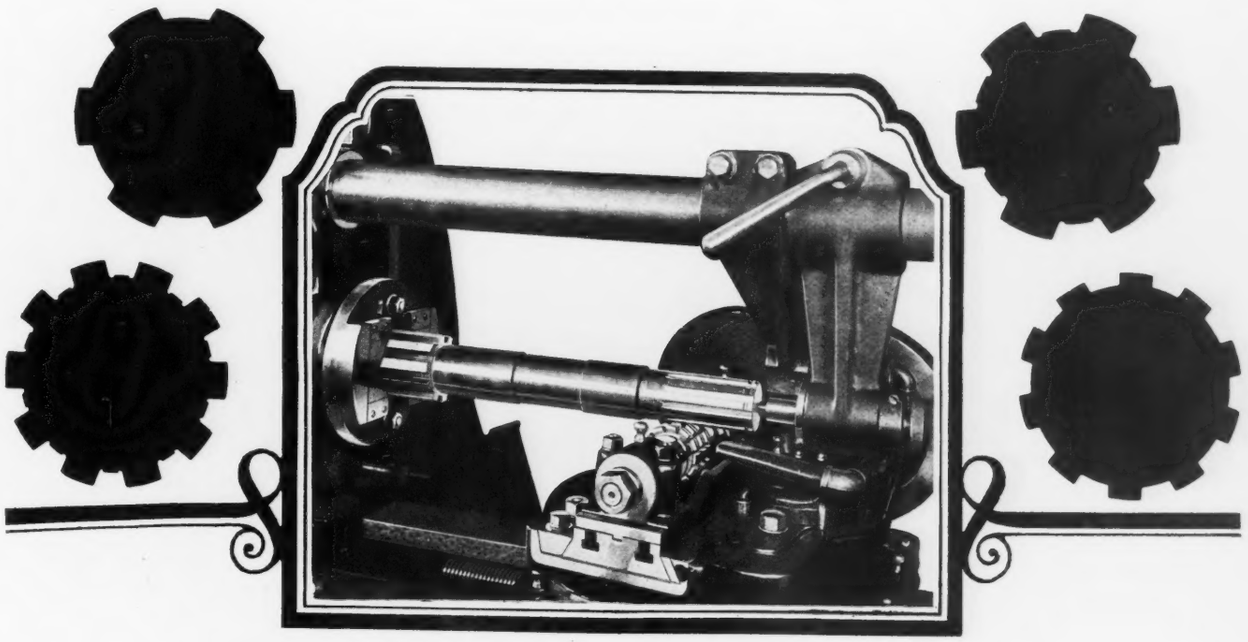
The Wright's center of gravity is low. The flywheel and crankshaft being located beneath the dies. Power is transmitted to a lower gate or crosshead, guided on long ways taking both lateral and vertical thrusts. Four bronze bushed chrome nickel steel rods connect the lower gate with the punch carrying crosshead. This precludes torsional strains on upper crosshead, assures direct vertical pull at corners and the perfect alignment of punch and die otherwise only achieved with a sub-press.

Send for Descriptive Circulars.

The Henry & Wright Manufacturing Company

Builders of Dieing and Drilling Machines

760 Windsor Street **Hartford, Conn., U. S. A.**



Spline Shafts

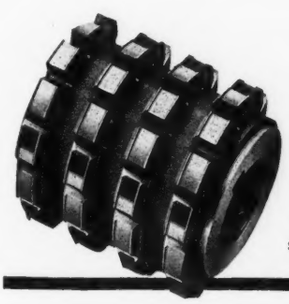
The Spline Shaft has come into general use by reason of its wide adoption in automobile construction, where it has proven its practicability.

This adoption of the Spline Shaft has received further impetus by the development of two modern processes that have made it a practical manufacturing proposition—the pull broaching process and the hobbing process.

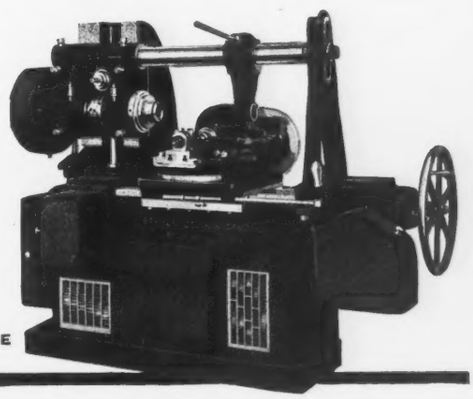
Hobbing Spline Shafts is the same in principle as hobbing gears—the work and hob both rotating, the cutting is continuous until the cut is finished. This eliminates the possibility of inaccuracy by distortion from localized heating in cutting and insures accurately indexed keys.

It should be as evident as it is actual, that no other process can equal the Hobbing Process in producing accurate Spline Shafts.

Submit your spline shaft problems to our engineers for solution. Our experience and research are at your service.



BARBER-COLMAN
SPLINE SHAFT HOB



BARBER-COLMAN
NO. 12 HOBBING MACHINE

BARBER-COLMAN COMPANY

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AMERICAN SWISS FILES

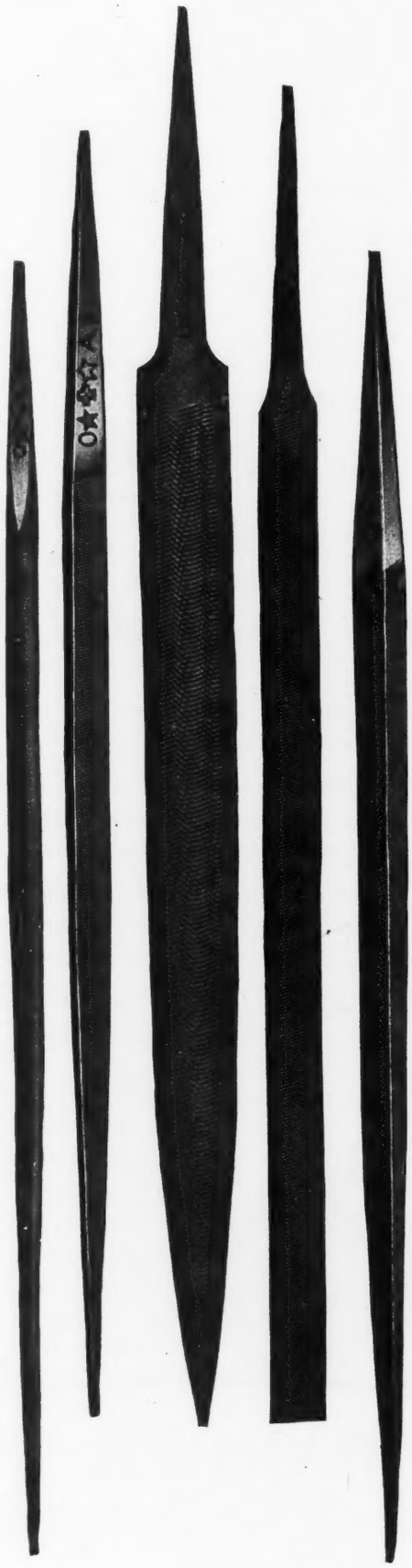


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AMERICAN SWISS FILE & TOOL COMPANY

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Perfect
Accuracy
Tell the Story
of the Success of
"MORSE"
Twist Drills
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NICHOLSON FILE CO.

PROVIDENCE, R.I., U.S.A.

THE JOHNSON FRICTION CLUTCH

As Used on the New Pratt & Whitney Vertical Shapers

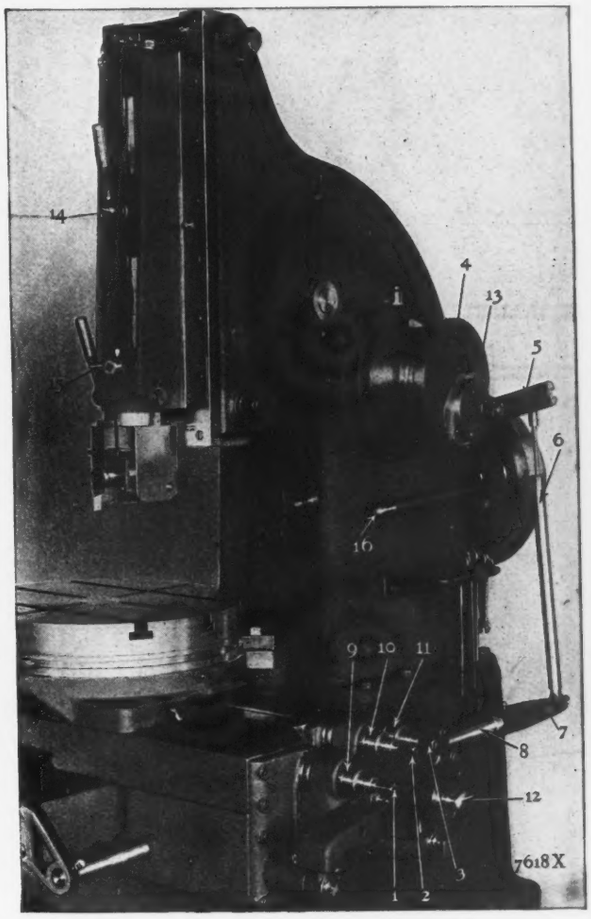
The Pratt & Whitney Co., first to use JOHNSON FRICTION CLUTCHES, has used them continuously since 1884. Reasons why—Reliability—Compactness—Smooth Exterior—Smooth in Operation—Starts Without Jerk or Jar—easily made to suit particular conditions—long life—very powerful for its size.

Try one for medium or light power and be convinced.

When the machine is driven from overhead shaft, a cone pulley is mounted on Clutch Hub.

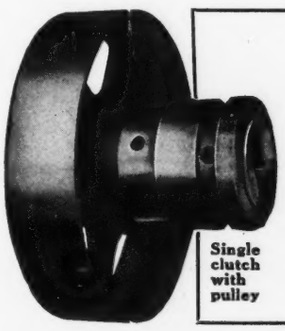
THE JOHNSON FRICTION CLUTCH with a cone pulley makes an ideal installation.

Where individual motor is used, a pulley is mounted on Clutch Hub as shown in small cut below.



Courtesy: Pratt & Whitney Co., Hartford, Conn.

A Sprocket mounted on Clutch Hub is frequently used on drives of short center distance. Pulleys, Gears, Sprockets can be mounted on the hub of THE JOHNSON FRICTION CLUTCH with equal ease.



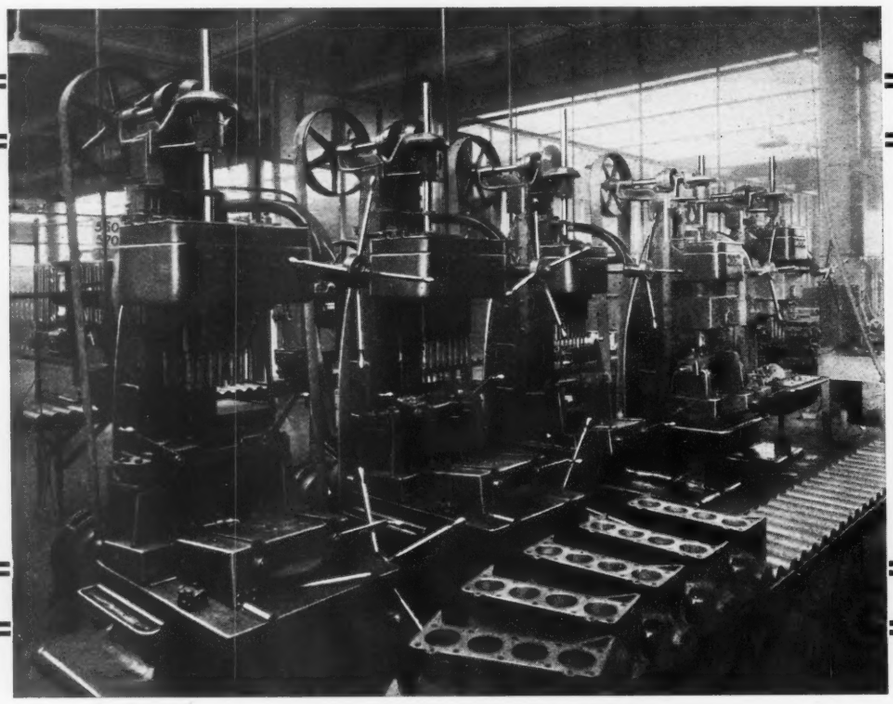
Single clutch with pulley

The JOHNSON FRICTION CLUTCH is made in both single and double types. The double type of Clutch is extensively used in nest of bevel gearing to obtain a reverse motion. It replaces the jaw clutch on account of its smooth pick-up when engaging.

Consult our Engineering Department when you have a Clutch problem, as they are capable, through years of experience, of handling such problems to your satisfaction. Write us to prove it.

Send for "Friction Control" Literature "A"

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.



FOOTBURT

Over 70 Railway Systems Have Installed FOOTBURT Equipment

You are vitally interested in faster, more accurate, more economical drilling, boring, reaming and tapping. Is there any good reason for ignoring the example set by over seventy railway systems and hundreds of factories that have installed FOOTBURT equipment? These great industries have by choice specified, purchased and are using FOOTBURT Valve Hole Drilling Machines, Cylinder Boring Machines, Four Way Drilling Machines, Valve Grinding Machines, High Duty Drilling Machines, Independent Feed Drilling Machines and Piston Turning Machines.

They will continue to add to this equipment as demand shows the need—because they are satisfied.

The five FOOTBURT valve hole machines shown are part of a well-known automobile plant's facilities. The fact that one operator handles the entire group accentuates the low operating cost and accuracy. If the work produced were not 100% accurate, maximum supervision would be necessary to insure each machine's correct performance. Tell us what you make and we'll tell you where we can help you.

THE FOOTE-BURT COMPANY, Cleveland, Ohio

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"Pioneers in Better Drilling Methods"

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FOREIGN AGENTS: Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Moscow Tool & Engine Co., Moscow. Ing. Ercole Vaghi, Milan. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stokvis & Fils, Brussels. Glaenzer & Perreaud, Paris agents for France, Switzerland, Spain and Portugal. Mitsui & Co., agents for Japan, Korea and Manchuria.

W&B

CAPACITY



THERE can be no doubt about the capacity of a Whitman & Barnes drill or reamer.

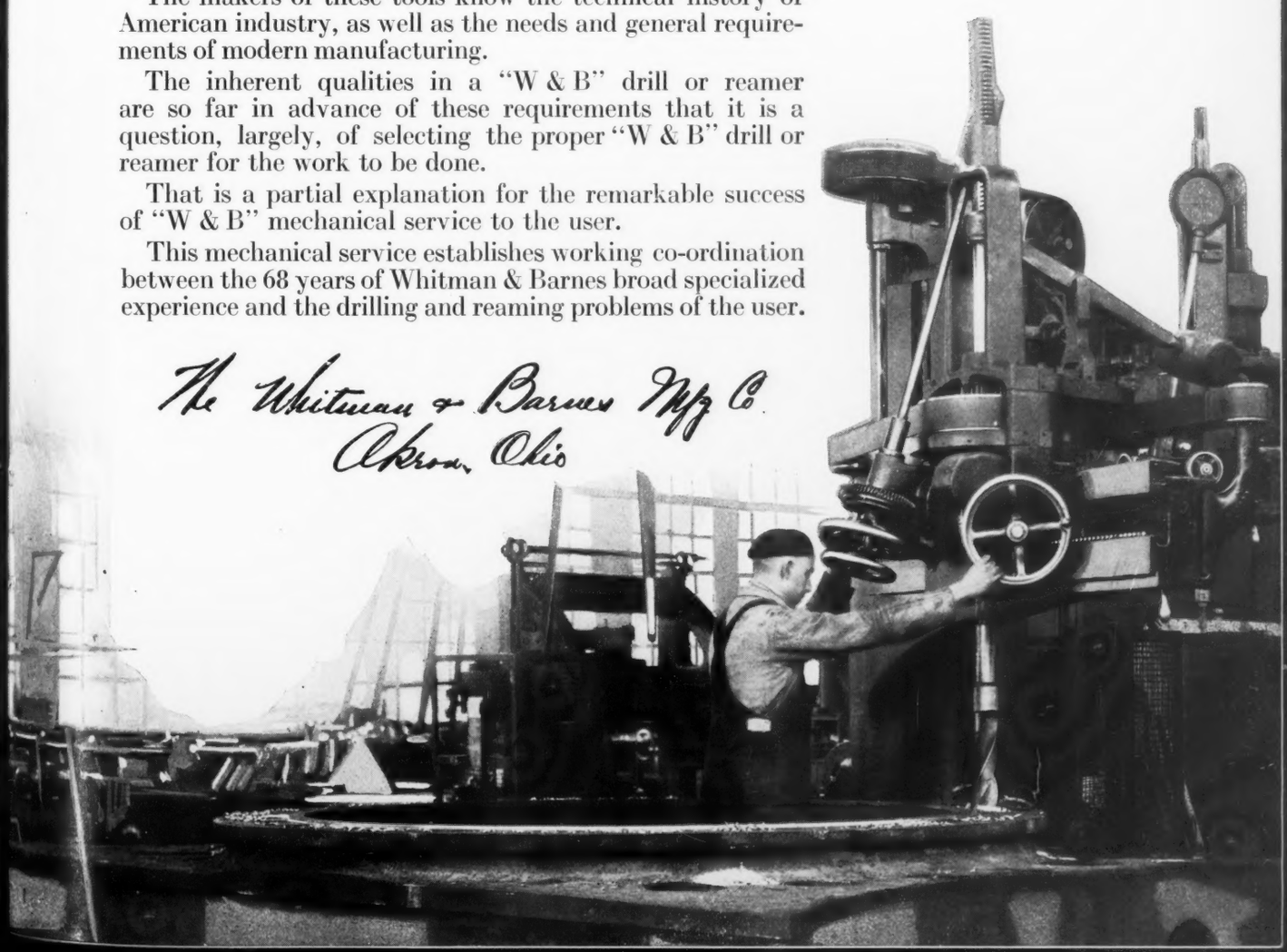
The makers of these tools know the technical history of American industry, as well as the needs and general requirements of modern manufacturing.

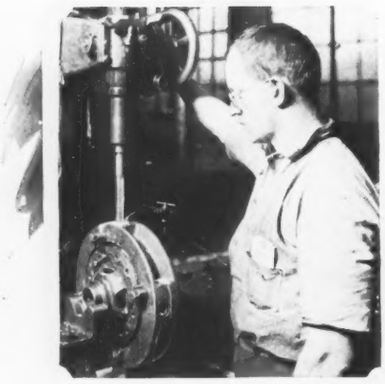
The inherent qualities in a "W & B" drill or reamer are so far in advance of these requirements that it is a question, largely, of selecting the proper "W & B" drill or reamer for the work to be done.

That is a partial explanation for the remarkable success of "W & B" mechanical service to the user.

This mechanical service establishes working co-ordination between the 68 years of Whitman & Barnes broad specialized experience and the drilling and reaming problems of the user.

The Whitman & Barnes Mfg Co.
Akron, Ohio





Brown-Lipe-Chapin malleable iron and steel forged differential cases are here being drilled with ¾-inch drills to a depth of ¾ inches, 4 holes to the casing, at a rate of 60 cases per hour.



A Brown-Lipe-Chapin four spindle drill press with "W & B" drills, drilling oil holes in 3½% nickel steel side pinions, at a continuous rate of 350 pieces per hour.

Brown-Lipe-Chapin

BROWN-LIPE-CHAPIN is a name which has loomed large in the automobile industry from the very beginning.

In the manufacturing of differential gears, 70 per cent of the manufacturers of quality automobiles are served by Brown-Lipe-Chapin.

Throughout the Brown-Lipe-Chapin shops all production facilities are in keeping with the high quality of the finished product.

Whitman & Barnes have been able to contribute to this splendid efficiency, both by the service they have been able to render, and the drills and reamers which they have supplied.

In the matter of service—the amazing production efficiency in operations like those pictured above is the usual direct and immediate result of Whitman & Barnes personal mechanical service.

"W & B" Warehouses

64 Reade Street, New York City
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Whitman & Barnes

AKRON, OHIO

Manufacturers of **TWIST DRILLS AND REAMERS** ***Exclusively***



Making a Brake Chain Clevis on the

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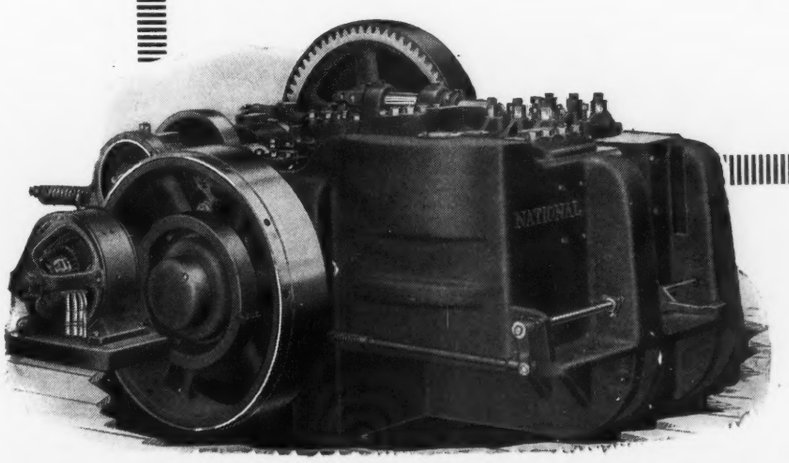
Heavy Pattern (Steel Bed) Forging Machine

While this clevis is a comparatively simple forging to make, it is held to such a degree of uniformity in size and finish in the National as to excite considerable comment. This uniformity in size and finish, together with the entire absence of distortion or swelling of the shank, is proof of the power and great rigidity of the "grip" of the National Heavy Pattern Forging Machine.

With such gripping power, work can be made to very close dimensions; and, where forgings are to be machined, material saving is effected in metal as well as in cost of finishing.

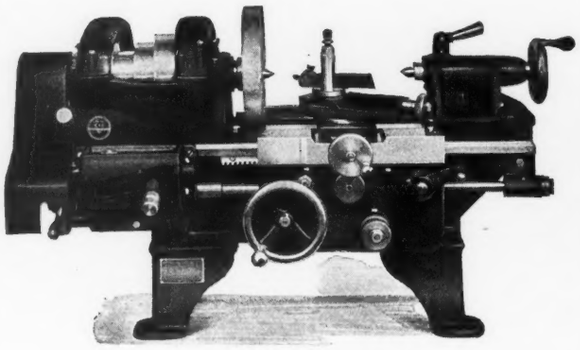
Submit your forging problems to our Engineering Department for solution.

THE NATIONAL MACHINERY CO.
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Are you receiving National Forging Machine Talks?

Monarch Lathes Lead

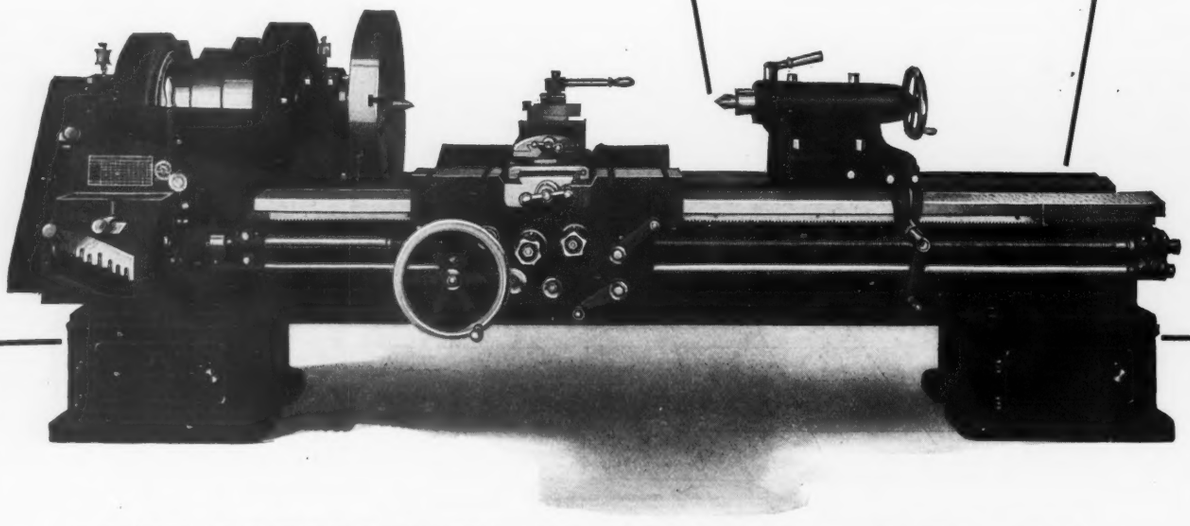


All sizes and styles. Special equipment is furnished on all Monarch Lathes from 9-inch to 30-inch swing.

They are always manufactured in such large quantities that the production cost is kept to the minimum and the buyer saves in first cost.

The first cost isn't the only saving the buyer makes. *Repeat orders* from MONARCH USERS testify to the accuracy and lasting qualities of Monarch Lathes. The MONARCH factory is busy. MONARCH Lathes are selling. Investigate Monarch before buying any lathe from 9 inches to 30 inches in size.

From the little Monarch Junior 9-inch lathe weighing 500 pounds, to the massive 30-inch Monarch weighing 8500 pounds, there will be found a lathe meeting your requirements. And at a price you will consider very reasonable.



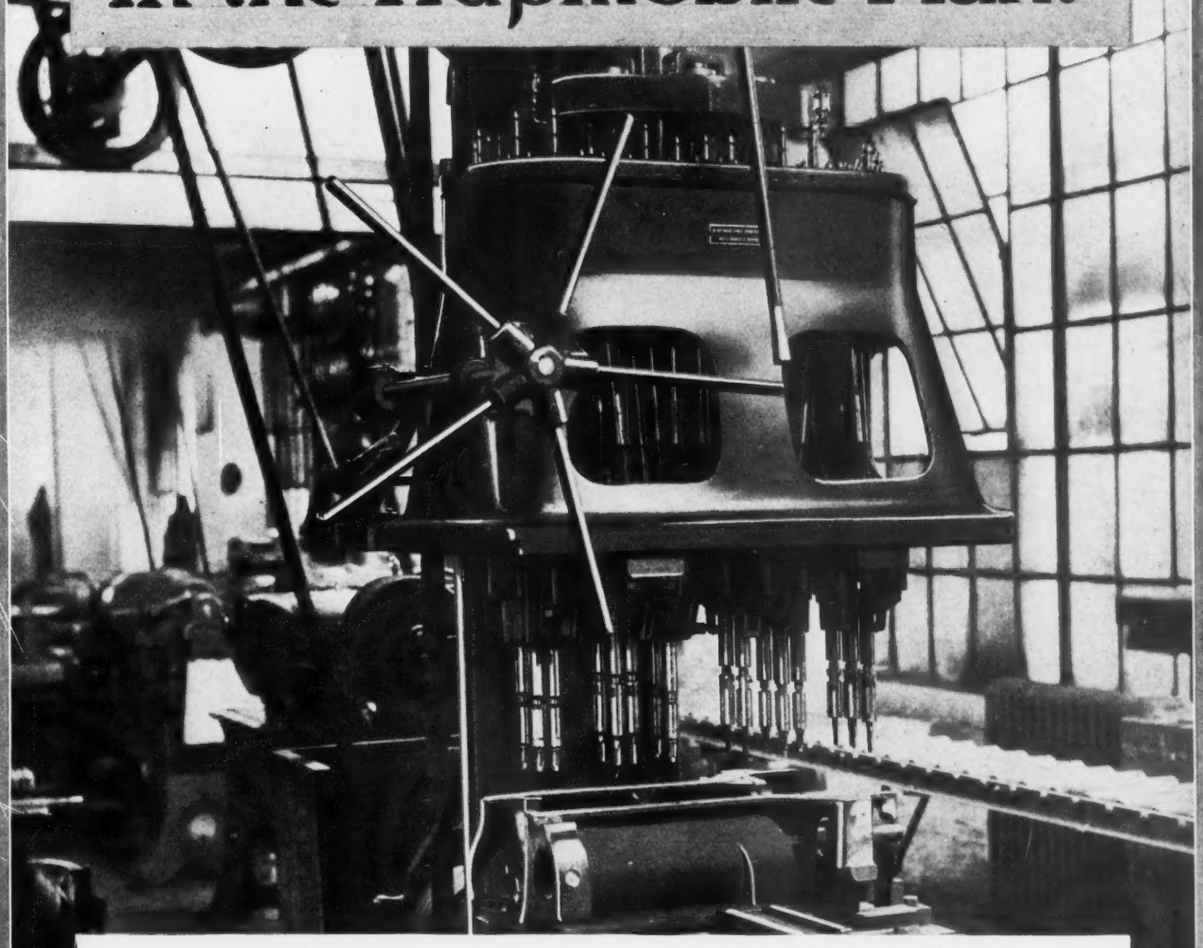
THE MONARCH MACHINE TOOL CO.

209 Oak Street, Sidney, Ohio, U. S. A.

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NATCO
In the Hupmobile Plant



Tapping
10 Holes in 10 Seconds

These two operations are done on the same NATCO, a No. 30. Hupmobile Cast Iron Crank Cases comprise the work. The holes are tapped ½ in. diameter and 1¼ in. deep; time, ten seconds. Another group of ten spindles counterbore ten ½ in. holes to ⅝ in. and ⅝ in. deep; time, 20 seconds.

The spindles on this NATCO are so arranged that the counterboring spindles are clear of the crank case when the tapping is done, and vice versa. Because of our patented Independent Change of Speeds the tapping spindles and the counterboring spindles are each driven at their correct speeds.

Counterboring
10 Holes in 20 Seconds

No matter what the character of your work is, if it is in the realm of multi-drilling the NATCO way will be of dollars and cents interest to you.

The National Automatic Tool Company
Richmond, Ind., U. S. A.



Battery Installation of New High-speed Gear Shapers. One 6-H.P. Motor furnishes Ample Power for Ten Machines.

Power Used to Overcome Friction is Wasted

It does not produce anything but heat, which in a production machine is wasted energy.

The new High-speed Gear Shaper is full ball bearing equipped, automatically lubricated, and with all reciprocating members light weight; therefore, the power consumed is unusually low.

A one H.P. motor furnishes more than ample power to operate a single machine at full capacity, whereas a six H.P. motor will easily fulfill the power requirements of ten machines.

Floor space required is one-third less than any other gear cutting machine having the same capacity.

The installation of a new High-speed Gear Shaper will undoubtedly reduce your overhead and production costs.

Give us an opportunity to prove it.

The Fellows Gear Shaper Company

SPRINGFIELD, VERMONT, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India) Ltd., Head Office, Calcutta, India. PACIFIC COAST REPRESENTATIVES: Eccles & Smith Company, Portland, Oregon; Seattle, Washington; San Francisco and Los Angeles, Calif.

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DAVIS-BOURNONVILLE CO.

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A strong, dependable, oxyacetylene torch—the embodiment of years of experiment and test. Widely sold, and quality proved under all conditions of service. A style for every class of work.

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Controls the manufacture and sale of National Carbide

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"Airco Oxygen and Acetylene Service is Good Service"

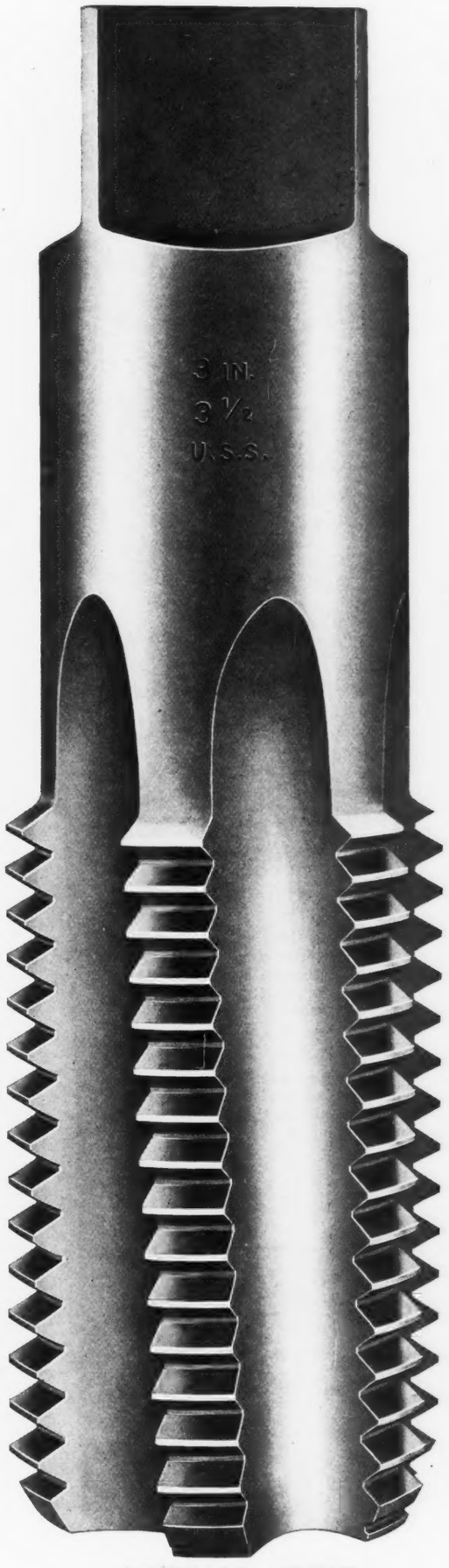


Some Samples of Work Threaded in Our

Universal Semi-Automatic Thread Milling Machine

Maximum Threading Capacity—External 7½ in. Dia.—Internal 6¼ in. Dia.

THE HANSON-WHITNEY MACHINE COMPANY, Hartford, Conn.



—ACTUAL SIZE—

"HANSON"
H
PROCESS

PATENTS PENDING

Standard Hand Taps of all sizes.

Finished after hardening.

ACCURATE DIAMETER

ACCURATE LEAD

THE HARTFORD TAP & GAUGE COMPANY

HARTFORD, CONN.

Say!.....

What's this—another questionnaire?

Well, no, not exactly—

But suppose you knock off for a few minutes and ask yourself these nine questions:

—Is my oil house as clean and orderly as my tool room?

—Am I proud of my storage facilities?

—Do I have oil barrels emptied into tanks right away, or do I let them stand around and collect dust, dirt and rain?

—When I have oil cans standing around machinery, do I keep them clean, thus keeping grit out of the bearings?

—Is my oil carefully labeled to prevent mistakes on the part of oilers?

—Have I a good checking system to let me know accurately how much of each kind of oil I am using per unit, or per shop?

—Do I know promptly when any kind of oil is running low?

—Do I insist that all employed around here use oils only for the purpose intended?

—Is my oil filtering system adequate and is it regularly inspected and cleaned as soon as necessary?

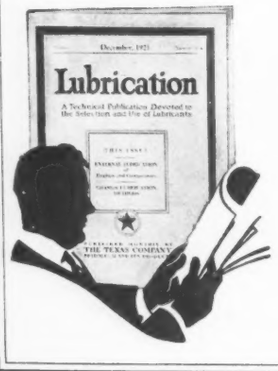
IF YOU can give an unqualified 100% "YES" to all those nine questions, why, then, your "Harp and Halo" are awaiting you.

But seriously, we want to tell you this: Texaco Lubrication Engineers travel through hundreds of plants, shops and mills weekly. They see many fine things. Whenever one or more of the above features are manifested at nearly 100% perfection, they take notes.

Hence, by pooling their experiences, we can give you a pretty good idea of the best form of oil storage, equipment and records for YOUR plant; and thus we can help you in your attempt to achieve perfection.

Now, in addition to giving you the right oil for any purpose, Texaco Lubricating Engineering Service can tell you how to use these oils to the best possible advantage.

Free Subscription Blank



THE TEXAS COMPANY

Texaco Petroleum Products

Dept. F, 17 Battery Place, New York City

Offices in Principal Cities

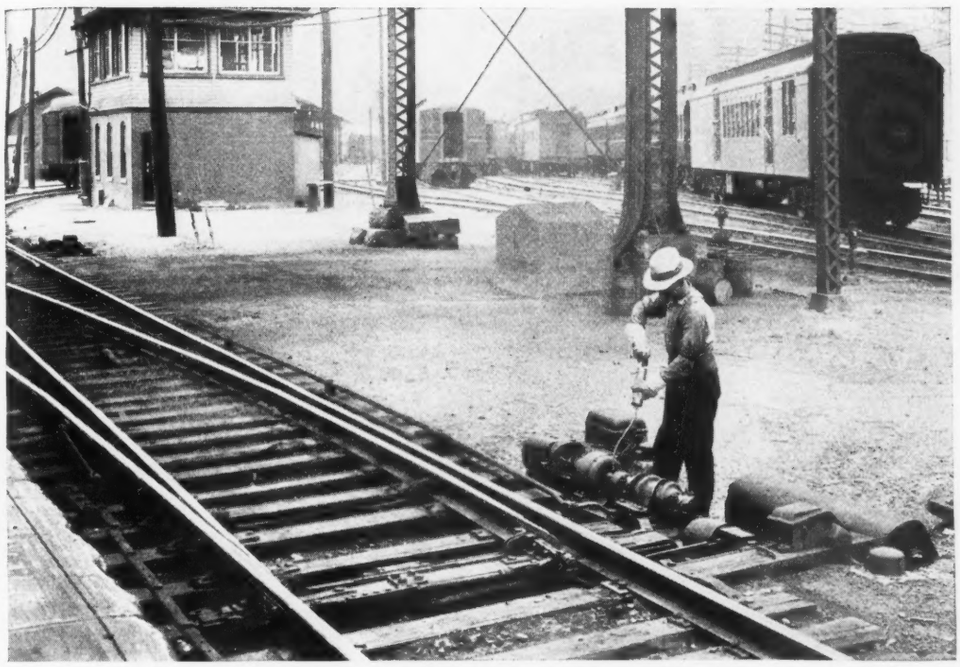
This coupon, when filled out and mailed to us, entitles you to a FREE subscription to our magazine, "Lubrication." Published monthly by us and devoted exclusively to the scientific selection and use of lubricants.

Name.....

Street.....

City..... State.....

8-22



With Alemite, all the operator has to do is to attach the flexible hose to any fitting—give the compressor handle a turn or two—and clean lubricant shoots into the bearing under 500 pounds' pressure

SIGNAL Engineer D. W. Richards of the Norfolk & Western Railway says: "The results we have obtained by the use of Alemite lubrication on the motor-operated switch and signal movements of our electric interlocking plants have been entirely satisfactory.

"We find, in addition to giving the best lubrication, the Alemite System saves much labor. Now a man goes over the whole job in one quarter of the time it took with the old method and it is necessary to lubricate only about once a month instead of once a week."

Alemite is the easiest and most thorough method of lubricating lathes, punch presses, conveyors, cranes and other types of industrial machinery. It eliminates the tendency to overlook certain parts, helps prevent bearing failures, saves tie-ups. Ask the Alemite representative near you to talk over your plant lubrication problems with you.

A Product of
THE BASSICK MANUFACTURING COMPANY
Chicago, Illinois
Alemite Products Company of Canada, Ltd., Belleville, Ontario



ALEMITE

High pressure lubricating system



Making the Load Lighter

ROYERSFORD Sells COMMERCIAL ROLLER BEARINGS

We know that you will be interested in "Facts" and "Just Facts" in this booklet.

They tell coldly the story of the Royersford Sells Commercial Roller Bearings for *your judgment*.

ROYERS

COMMERCIAL

A Smaller Bearing for a Heavier Load Means Lower Installation Cost

The rollers of the Royersford *Sells* Commercial Bearings are solid. Their ends are retained in heavy cage rings. This keeps the rollers *always separated* and *always parallel to the axis of the shaft.*

The Royersford *Sells* Roller Bearing is furnished with or without the unit lining. In case you are using a steel housing, allow the rollers to bear directly against its steel lining.

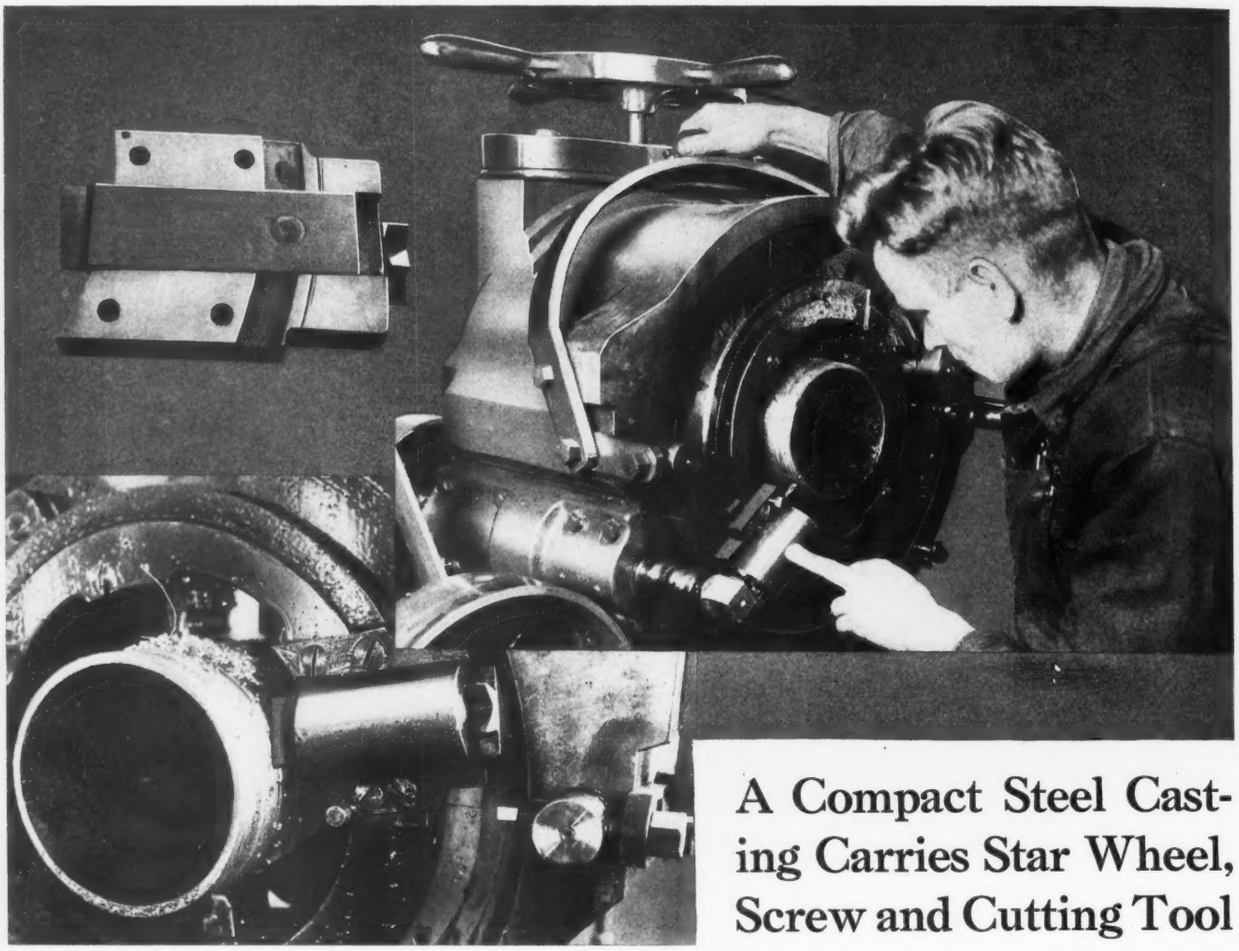
We would like to tell you more about Royersford *Sells* Commercial Roller Bearings—to answer some of the questions which we know you would like to ask—their costs for instance.

Suppose we have one of our engineers call. There will be no obligation. At least we can send our new booklet "Making the Load Lighter." It's complete even to prices and sizes. It will be in your hands within a couple of days if you write us—just a few words—**NOW.**

Royersford Foundry & Machine Co.
54 N. 5th Street, Philadelphia

FORD *(Sells)*

Roller BEARINGS



A Compact Steel Casting Carries Star Wheel, Screw and Cutting Tool

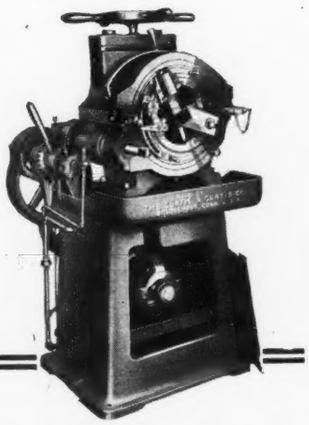
A simple and effective Cutting-Off Device is one of the unique features of the New "Forbes" Pipe Machine. It is carried on the outer face of the die head, which is readily moved along the pipe and locked in cutting position.

The cutting tool is fed down to the work by means of a star wheel on the end of the feed screw; after which a pin at the side of the machine is adjusted to contact with the star wheel and indexes it 1/6 turn at each revolution of the die head.

Feed screw is nicely adjusted to make the cut as heavy as may be without danger of crowding or breaking and the tool and its kerf are automatically flooded with lubricant during the whole operation.

The "Forbes" principle—rigid work and rotating cutters—together with the New Three Point Vise, Automatic Die Release and other exclusive features save time and labor and power costs wherever these machines are installed.

Close-up of the cutting-off device shows how a plug formed on the side of the feed screw nut projects into the cutter and advances it at every index of the star wheel.



Next month the New Die-Head.

The Curtis & Curtis Company

324 Garden Street **BRIDGEPORT, CONN.**

The New FORBES

PIPE CUTTING and THREADING MACHINE

HASKINS EQUIPMENT IN THE WORLD OF WORK

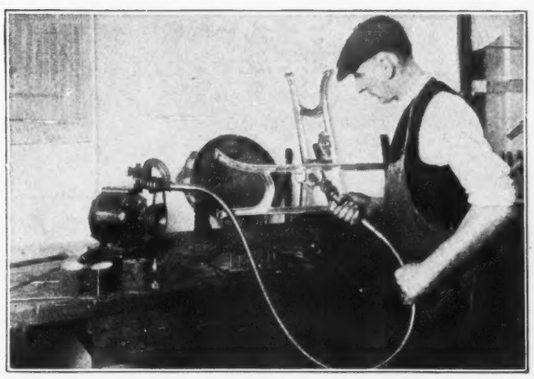
No. 4 Building Service

Instantaneous Hot Water Heaters are built for Service. Day or Night they must respond to the turning of a faucet.

It is significant that HASKINS Equipment is selected to help build this service into these machines—requiring careful, conscientious workmanship.

HASKINS Flexible Shaft Equipment can help you build Service into your product. They will allow you to increase the quality of your output and at the same time reduce production cost.

Write today—we will go over your problem, and arrange a practical demonstration of our machines without cost or obligation to you.



R. G. HASKINS COMPANY
27 S. Desplaines St. CHICAGO, ILL.

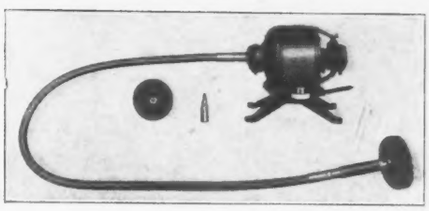
Distributors for Pacific Coast:
Mohr Brothers Co., 233 Pacific Bldg., San Francisco, Calif.



From early morn till late at night there is a continuous supply of piping hot water when the Ruud Automatic Water Heater is used.

Ruud Manufacturing Co.
PITTSBURGH, PA.

USE



Haskins Type RB-6

For Profitable Die Work



IN THE LABORATORY

The microscopic examination of a sample of brass makes it possible to see the inner structure of the metal at any desired magnification.

"Consider the Brass"

Durability, elasticity and *uniformity* are the factors that insure profitable production on this work.

The big punch presses operate with clock-like precision, but if the brass is not uniform, cracks, strains and other imperfections mar the work. Experience has taught us to produce good brass—Science enables us to make it uniform. That's why we consider our laboratory as important as any other part of the work. Only by the scientifically accurate tests made by experts working with highly sensitive apparatus can we tell why the brass we specify for a particular job will give the desired results; can we guarantee that the quality of future lots for the same purpose will *not vary*—though years separate the orders.

For uniform results in the matter of production and work—in other words, uniform profits—make sure of your material. Specify Chase Brass.

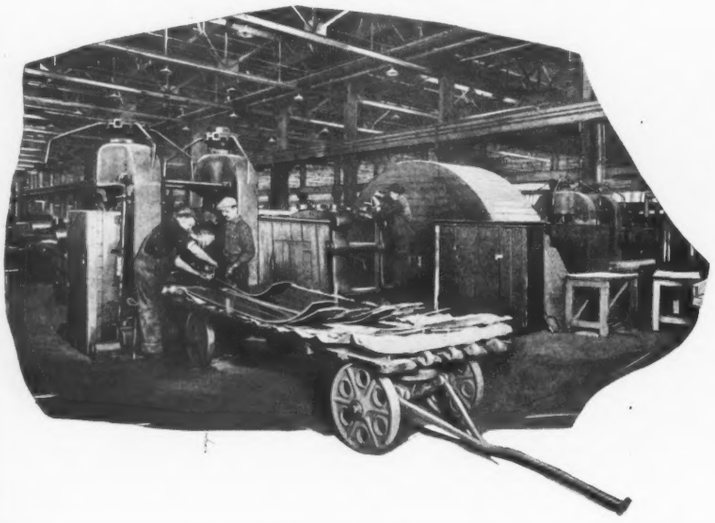
CHASE METAL WORKS

Division of Chase Companies Inc

WATERBURY CONNECTICUT

PLANTS

CHASE METAL WORKS — Trade CHASE Mark — CHASE ROLLING MILLS



IN THE SHOP

Rolling sheet metal—a job for an expert. The most efficiently designed rolling mills cannot reduce the need for **EXPERIENCE** on the part of the man who holds this job.

Trade CHASE Mark

HIGH SPEED HAMMERS

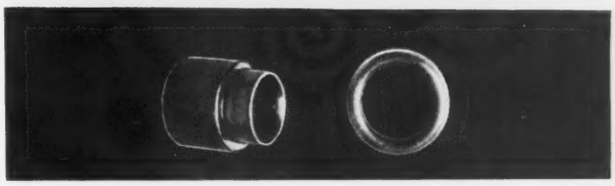
(PATENTED)

In the Famous *"Tycos"* Plant

In the world-famous *"Tycos"* factory one High Speed Riveting Hammer performs 300 riveting operations per hour. For ten years the machine in the picture has been at work in the Rochester, N. Y., plant of the Taylor Instrument Company—and it is still doing full duty.

The work shown is the case and partial assembly of a *"Tycos"* heat recording instrument familiar to all manufacturers engaged in the heat treatment of metals. The case is a brass stamping .064″ thick. In the small end of it, two brass shells with turned shoulders are inserted in holes, washers slipped over the protruding ends which are in turn riveted, fastening the tubes securely to the recorder case. Production is 150 cases per hour, which means assembling the shells and washers into position from 300 rivetings on the High Speed Hammer.





You will find it profitable to thoroughly investigate the efficient High Speed Hammer. It will serve you as well as it does "Tycos." Write us.

THE PRINCIPLE IS RIGHT

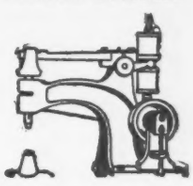


THE HIGH SPEED HAMMER COMPANY, Inc.

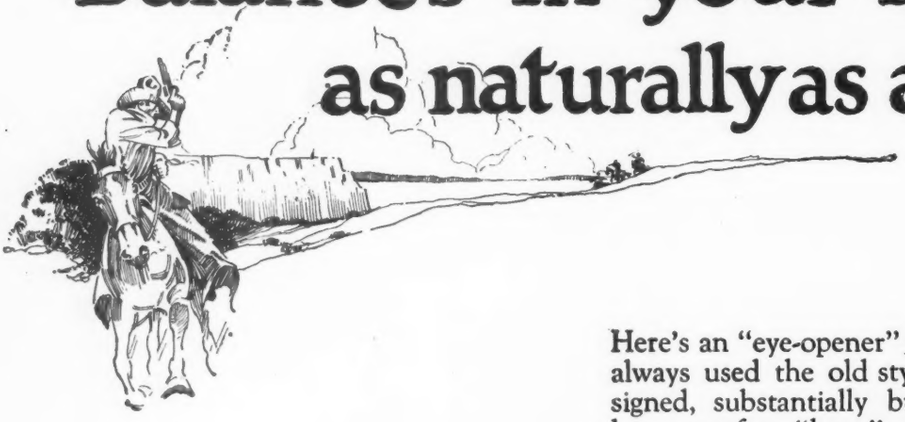
Rochester **New York**

CHICAGO BRANCH: C. W. Schuchardt, Mgr., 568 W. Washington Blvd. AGENCIES: F. O. Stallman Supply Co., 167-173 First St., San Francisco. Agents for Pacific Coast: Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China, Japan and South American Trading Company, Ltd., Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.

THE HAMMER WITH THE HUMAN STROKE



Balances in your hand as naturally as a Colt .45



Here's an "eye-opener" for the man who has always used the old style frame. A well designed, substantially built hack saw frame has a perfect "hang"—takes any length of blade from 8 to 12 inches and can be set to cut in four directions without removing the wing nut. A constant tension on the bolts holding the blade and a positive adjustment on the tubular back saves cuss words and much valuable time when changing blades. Hard rubber checked handle and stream line design. A Hack Saw Frame you will always swear *by*—never *at*.

Ask for *Starrett Pistol Grip Adjustable Hack Saw Frame No. 169.* You can get it at almost any hardware store.

Write for Catalog No. 22 D and the Supplement describing the new Starrett Tools.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.





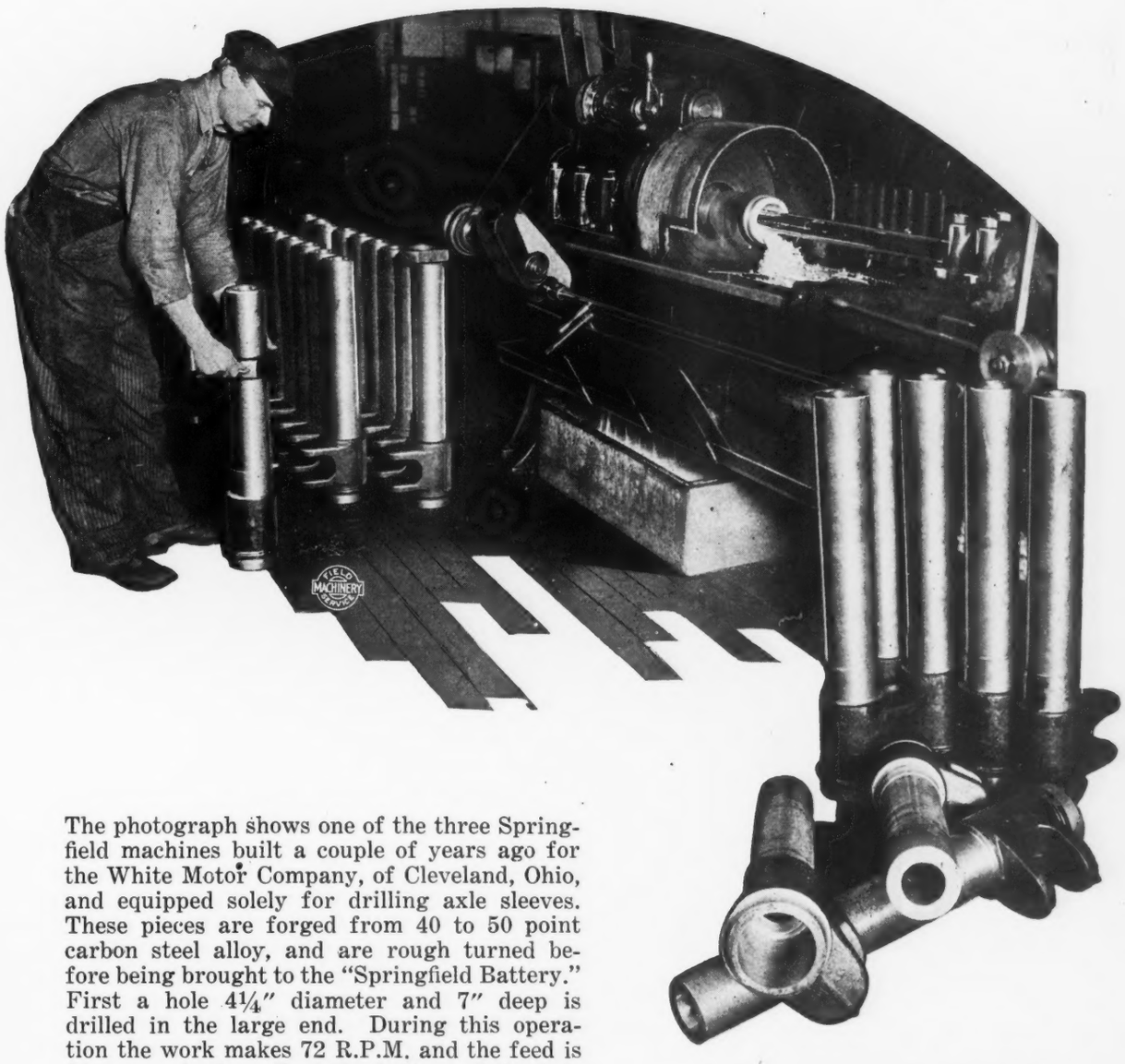
The Starrett Hack Saw Chart and "Hack Saws and Their Use" (a standard reference book on the subject) will be sent free on request

42-391

Starrett Hack Saws

Axle Sleeves for White Trucks Are Drilled on Three

SPRINGFIELD SPINDLE AND AXLE BORING MACHINES



The photograph shows one of the three Springfield machines built a couple of years ago for the White Motor Company, of Cleveland, Ohio, and equipped solely for drilling axle sleeves. These pieces are forged from 40 to 50 point carbon steel alloy, and are rough turned before being brought to the "Springfield Battery." First a hole 4¼" diameter and 7" deep is drilled in the large end. During this operation the work makes 72 R.P.M. and the feed is ½" per minute. Next the bottom of the hole is squared up, leaving only the depression left by the point of the drill. Into this a long drill, 2½" diameter, is put through the remaining 24" of solid steel with a feed of 11/16" per minute, while the work revolves at 96 R.P.M.

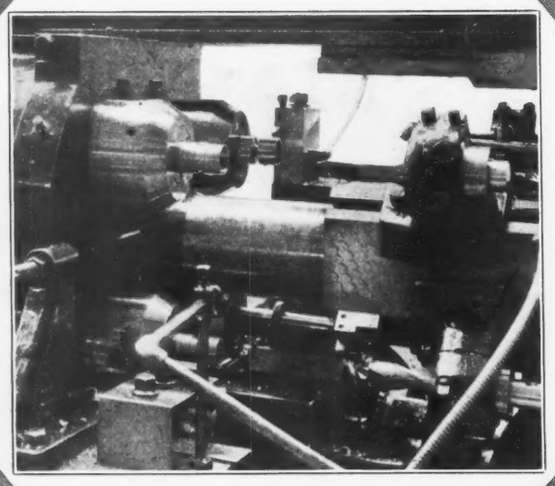
Tell us what you wish to accomplish; and—if it's a lathe job—we'll equip a "Springfield" for the task. Catalog describes the whole line.

THE SPRINGFIELD MACHINE TOOL COMPANY

Manufacturers of Springfield Lathes and Shapers

631 Southern Ave., SPRINGFIELD, OHIO

AGENTS: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Buffalo, Syracuse, New Haven, Pittsburgh, St. Louis, San Francisco, Seattle, Cincinnati. The E. L. Essley Machinery Co., Chicago, Ill. The Riverside Machinery Depot Detroit, Mich. The Cleveland Duplex Machinery Co., Cleveland, Ohio.



Fine Finish and Speed

Many manufacturers are sacrificing speed in production in order to maintain their certain standards of quality in finish.

Others have found, as did the user of the equipment illustrated above, that a GRIDLEY MULTIPLE SPINDLE AUTOMATIC provides the means for rapid production without any loss in reasonable accuracies.

Note the method of performing successive operations with a single advance of the tools, also rigid mounting of tool holders. Fine tool equipment also aids the maintenance of accurate finish.

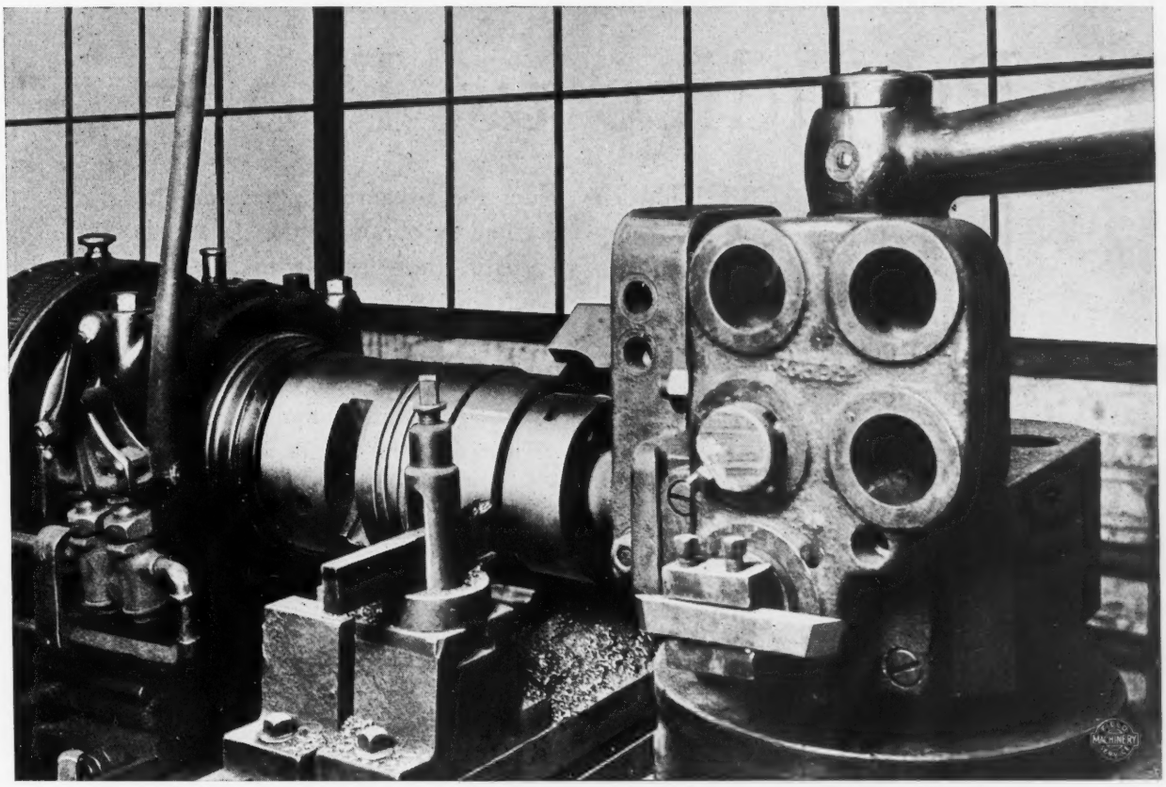
Quotations on your work without obligation

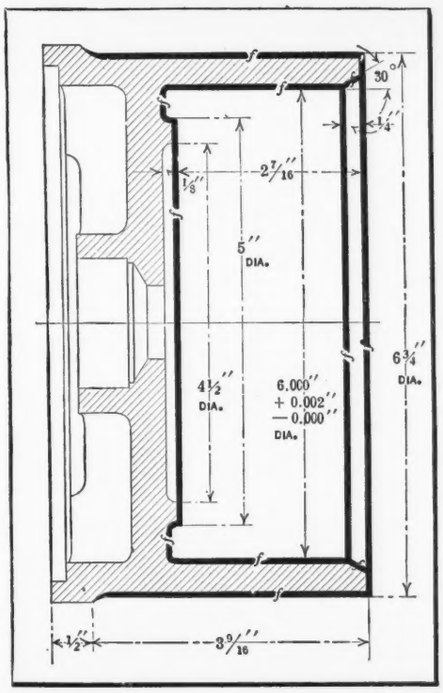
THE NATIONAL ACME CO.

CLEVELAND, O.

NEW YORK BOSTON BUFFALO CHICAGO WINDSOR, VT. DETROIT

P & J AUTOMATICS





Take the "Guess" Out of Your Production

If you know, then there is no need to guess. If you know in advance the cost per piece, the time per operation and the job's requirements in labor and material, then your production cost is pre-determined. Potter & Johnston Automatics give pre-determined production.

The accompanying photograph (exhibited through courtesy of the Manufacturers' Equipment Company, Chicago) shows the finishing operation on cast-iron cylinder bodies by a P & J Automatic. The routine is: 1, Bore and turn (using turret tool), and face (using cross-slide tool); 2, Chamfer (using turret tool). Time for each part, includes loading and unloading, 5 minutes, 50 seconds, and only one man is required to attend an entire battery of machines.

Let's tell you more about P & J Automatics—this is an invitation to ask questions.

POTTER & JOHNSTON, Pawtucket, R.I., U.S.A.

New York Office: Hudson Terminal Bldg., 50 Church St. Walter H. Foster, Manager. Detroit Office: The Potter & Johnston Agency Co., 535 Bates St. Chicago Office: 3057 Eastwood Ave., Leslie J. Orr, Manager. Pacific Coast Office. Rosslyn Hotel, Los Angeles, Cal. Charles H. Shaw, Manager. Foreign Offices and Representative: Office for France, Belgium, Switzerland, Spain and Portugal, Potter & Johnston Machine Co., 68 Ave. de la Grande Armee, Paris, France. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Ercole Vaghi, Corso Porta Nuova, 34 Milan Italy. Rylander & Asplund, Stockholm, Sweden. Yamatake & Company, No. 1 Yuracucho, Ichone, Kojimachiku, Tokyo, Japan.

Prejudice *vs.* Profit

MANUFACTURING plants are very often located in the immediate vicinity of the moving spirits of the organization, without any regard to the advisability of the district being the best for obtaining raw materials, transportation, labor, power, etc., or of it being in the center of the greatest market in which the plant will distribute its product.

It is a well-known fact that large corporations thoroughly investigate every possible location before deciding where a new plant will be built. Their foresight has always resulted in a marked advantage over competitors and decided increases in *profits*.

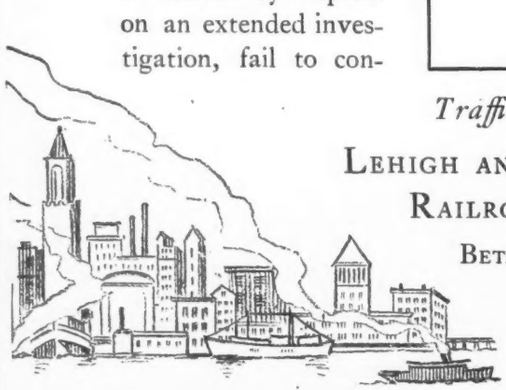
Many organizations, believing that they have neither the time nor the money to spend on an extended investigation, fail to consider the advantages that can be secured by obtaining the data and statistics that the railroads have to offer on any section that they may be considering.

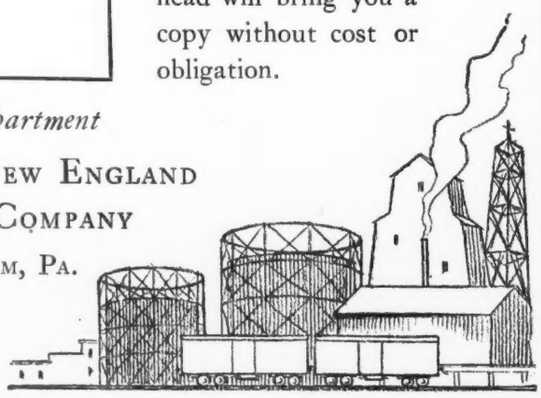
The railroads believe that their success depends upon the prosperity of the industries along their lines. They are therefore earnestly endeavoring to co-operate with the manufacturers in collecting all available data pertaining to different sites in order to assist the manufacturer in scientifically selecting the section of the country that would be *best* in which to locate any particular industry.

Some of the most pertinent data compiled by the Lehigh and New England Railroad Company on this subject, has been assembled in book form under the title, "Locating the Factory." A request on your business letterhead will bring you a copy without cost or obligation.

LOCATING THE FACTORY







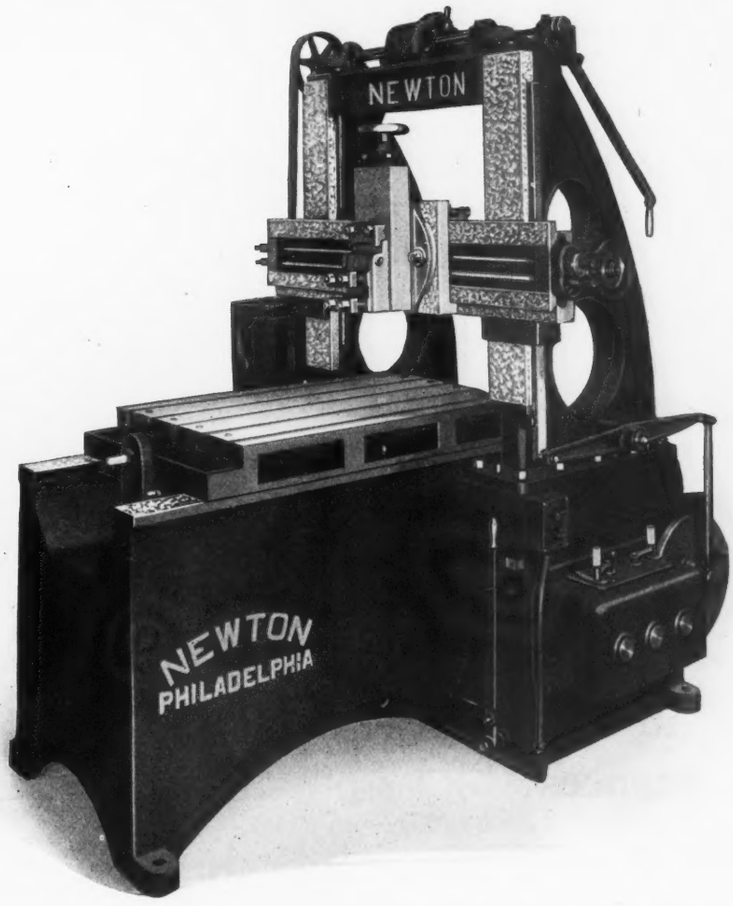
Traffic Department

LEHIGH AND NEW ENGLAND RAILROAD COMPANY

BETHLEHEM, PA.

NEWTON

(REGISTERED TRADE MARK)



CRANK PLANING MACHINE

Stroke 34 in. Max.

Positive stroke, quick return, proper speeds, 10 H. P. drive makes this the best tool for production on short single piece jobs.

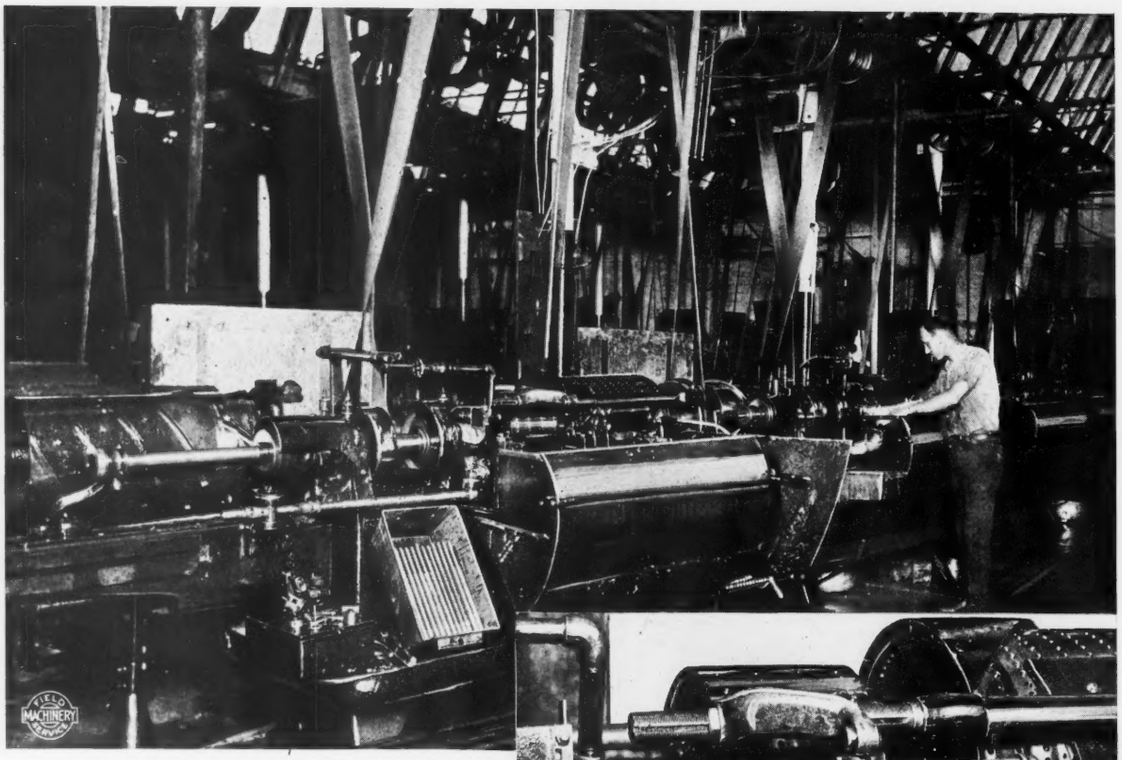
Slotting Machines **Milling Machines**

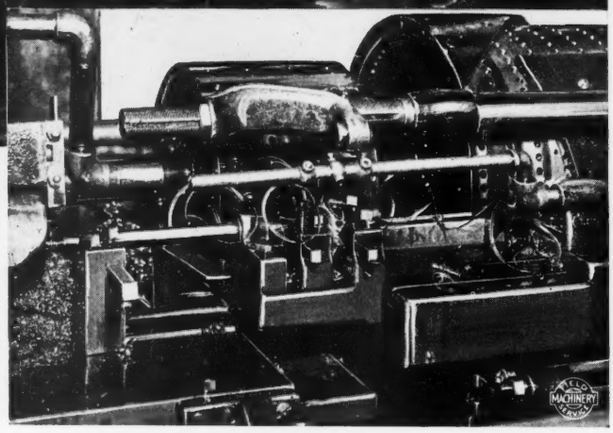
Cold Metal Sawing Machines

NEWTON MACHINE TOOL WORKS, Inc.

Twenty-third and Vine Streets **Philadelphia, U.S.A.**

CLEVELAND AUTOMATICS





32 in this Shop—the Result of 22 Years of Satisfactory Performances

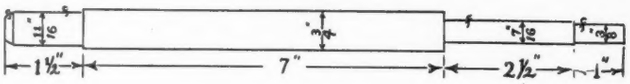
Turning both ends of worm screw spindles to within grinding size is the operation performed on this latest addition to the Cleveland Automatic department at the DeLaval Separator Company's plant, Poughkeepsie, N. Y.

These pieces are made from ¾" round bar steel, as follows: feed stock; turn two diameters on small end with box tools and at the same time bevel the large end with a tool mounted on the rear cross slide; turn diameter of large end with tool mounted on front cross slide, feeding longitudinally; cut off with tool mounted on arm, which rocks in.

Dimensions are specified in the accompanying sketch, and each piece takes 3 minutes, 5 seconds to complete.

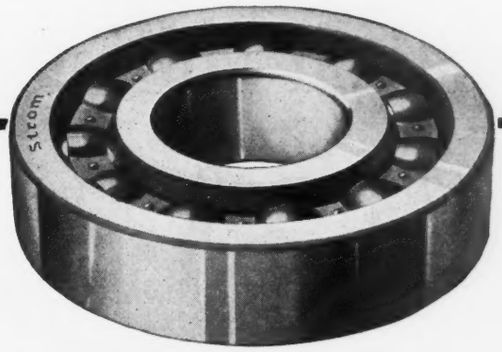
Let us estimate on some of your "automatic" work.

3/32" TO 8" 18 FEED — CLEVELAND'S CAPACITY UNEQUALED



The Cleveland Automatic Machine Company

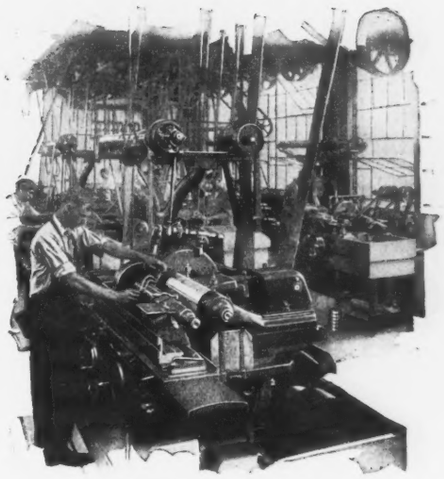
CLEVELAND, OHIO, U. S. A.



Grinding Accuracy in the Manufacture of STROM BEARINGS

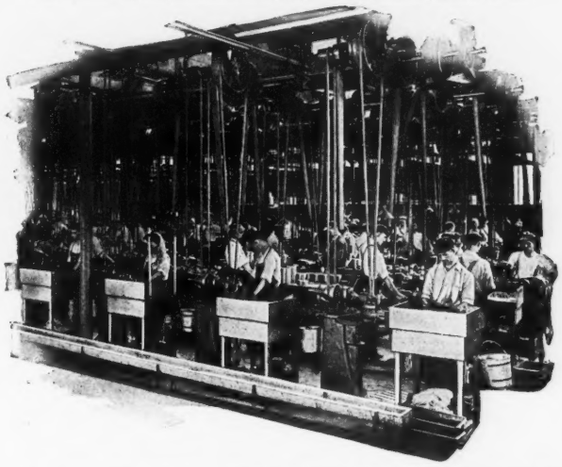
Bores, outside diameters, and widths are ground on precision grinders to limits measured within the ten thousandth of an inch, thereby insuring a uniformity of dimensions which enables the user to install Strom Bearings without further inspection or selection for his requirements.

Races are ground to true circumference and accurate contour. They have that smooth surface which is so essential to the reduction of friction.



Accurate Machine Tools and skillful workmanship are requisites in the manufacture of Strom Bearings

The Grinding Department is equipped for quantity production



These refinements are characteristics of the complete line of Strom radial, thrust and angular contact bearings.

Strom engineers are especially trained to solve bearing problems. They will be glad to work with you in determining the type and size of bearing that will give you the best results.

U. S. BALL BEARING MFG. CO., 4563 Palmer St., Chicago, Ill.

(Conrad Patent Licensee)

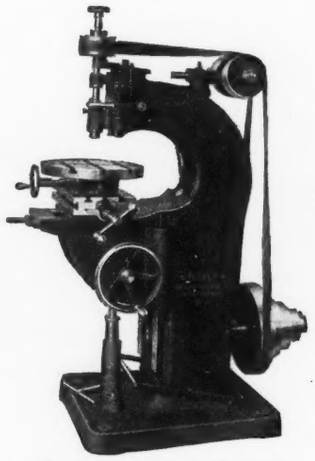
(204)

Strom BEARINGS

Becker Vertical Milling Machines

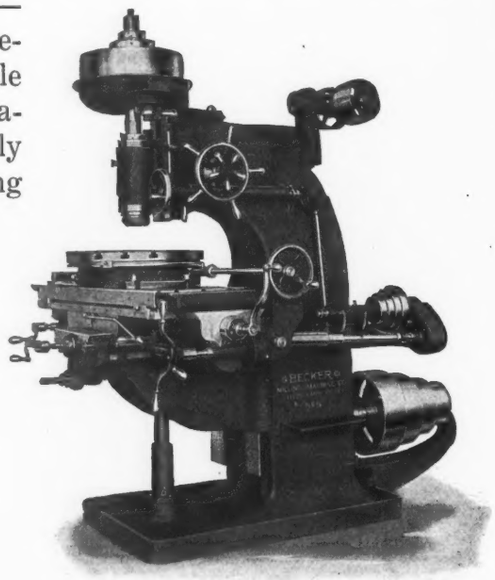
Operating Efficiency—Production Economy

Three models from our large line of standard type vertical milling machines—"The Machines That *Give the Smooth Finish.*" The Becker Standard Vertical Miller No. 2—our smallest machine—is a particular favorite with engravers and makers of small dies.

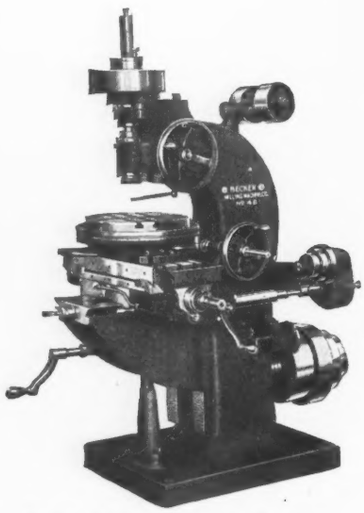


Becker Standard Vertical Milling Machine No. 2.

No. 4B has longitudinal feed of 28″, cross feed 14″ and vertical feed of knee 19″—maximum distance between spindle and table 19¼″. A wide range machine that is especially useful in manufacturing and repair shops.



Becker Improved Standard Vertical Milling Machine No. 6.



Becker Standard Vertical Milling Machine No. 4B.

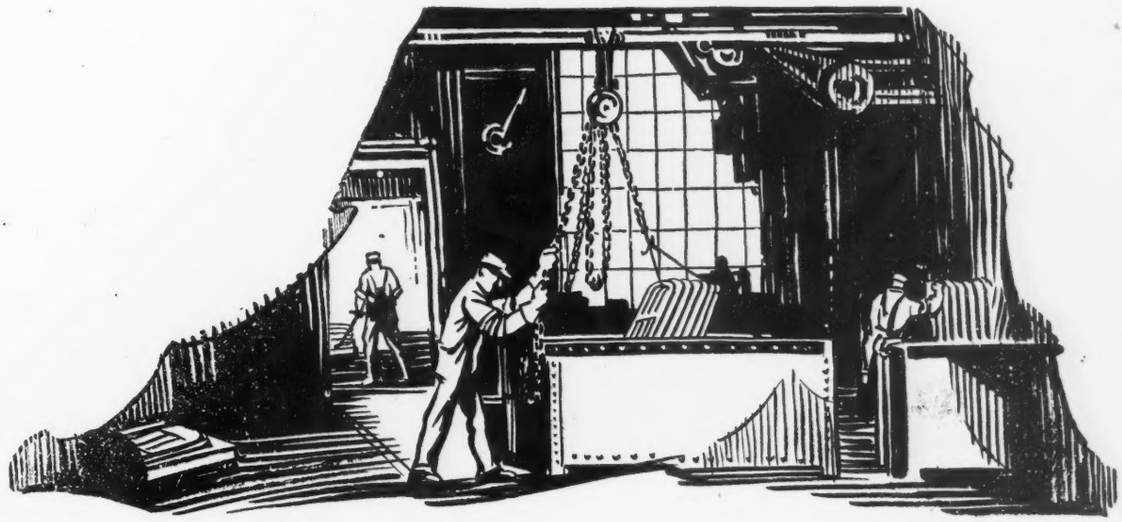
The Becker Improved Standard Vertical Milling Machine is an extremely powerful machine with unusual range. Longitudinal power feed 62″, power cross feed 20″, vertical power feed to table 22″; maximum distance between spindle and table 30″. A popular machine for automobile and die work.

Send for the details of the entire line; efficient machines in popular sizes.

BECKER-MILLING MACHINE COMPANY | REED-PRENTICE CO. | WHITCOMB-BLAISDELL MACHINE TOOL CO.

677 CAMBRIDGE STREET, WORCESTER, MASS.

SALES OFFICES: Indianapolis, Detroit, New York



How a bedstead manufacturer profited by a simple change in cleaning methods

This Advertisement is one of a series based on actual occurrences.

ONE of the cleaning jobs in this factory calls for the removal of anti-rust, brazing flux and oil from iron and steel bedsteads before enameling.

The work was performed in what was considered a satisfactory manner, by wiping down the bedsteads with gasoline. This cleaned the metal surfaces so that the enamel could be properly applied.

An Oakite Service Man had the opportunity, one day, to make definite recommendations for doing this work in a more economical manner.

A simple cleaning tank was installed, and filled with solution of Oakite materials costing 1/5 as much as gasoline. Bedsteads were soaked in tank six at a time. It was found that *one man* could put through as many bedsteads each hour as three men were able to handle without Oakite.

This saving in labor and materials, when converted into dollars and cents, is significant of the money saving results many factories and shops have realized by using Oakite.

The point is that even if your own cleaning work is not giving you trouble, it may be costing you more than is necessary, perhaps much more.

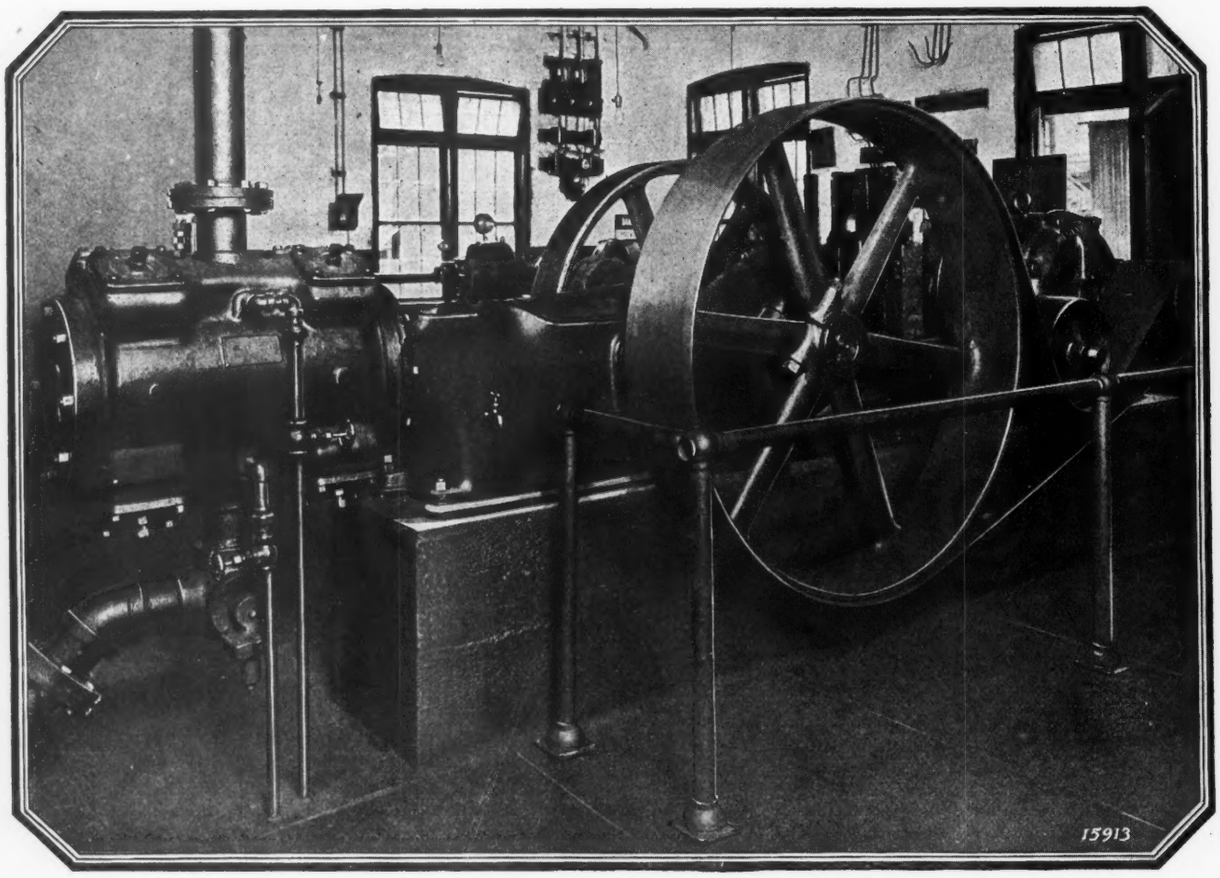
May we tell you about the many economies resulting from the use of Oakite materials? We have a number of booklets presenting technical facts in an interesting way on all kinds of cleaning work. We shall be glad to send you a booklet describing the use of Oakite for the kind of cleaning work you are doing. Write for copy now—no obligation.



Drop us a postal card—it is a little thing to do but a big step in the right direction.

OAKITE

MANUFACTURED BY OAKLEY CHEMICAL CO. 26 THAMES ST. NEW YORK



Use Air and Prevent Depreciation

Depreciation of motors, generators, machine tools and other machinery is often the result of dust and dirt, as well as natural wear and tear.

Compressed air jets clean machinery thoroughly and quickly for the air gets into corners and pockets which the brush cannot reach.

The location of such jets at convenient points in your shop will prevent needless loss of time and labor.

Cleaning is only one use for air. Pneumatic tools, hoists, and the air brush for painting, have done as much and more to increase production and improve the finished product.

The production of compressed air at the least cost per cubic foot requires a compressor which is durable and efficient. No matter what size or type is required there is an Ingersoll-Rand compressor which will do the work.

If it's compressed air consult us. In the meantime write for descriptive bulletins.

INGERSOLL-RAND CO., 11 Broadway, New York

Offices in all principal cities.

Ingersoll-Rand

647-C

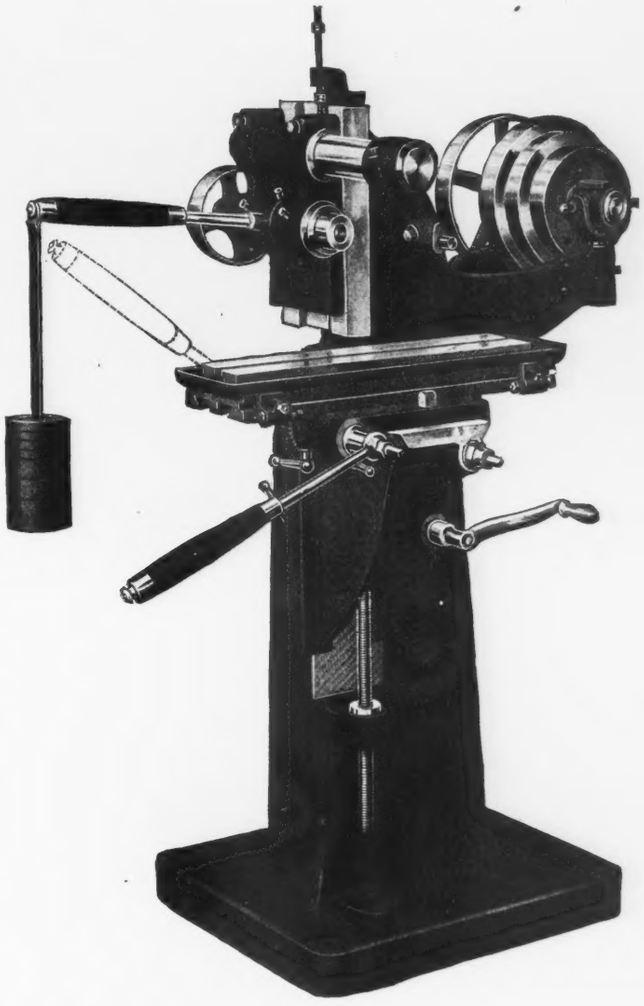
"WHITNEY"

HAND MILLING MACHINE

THOUSANDS IN USE

For a great many years we have devoted practically all of the energy of our Machinery Department to the production of this one machine, which long ago superseded all other sizes and styles of hand millers previously made by us.

The design is the result of years of study and experiment and the wonderful sale of the machine is a tribute to the excellence of its construction, the high character of its workmanship, and the accuracy and volume of its output. Adverse criticism is practically unknown.



PROMPT DELIVERIES

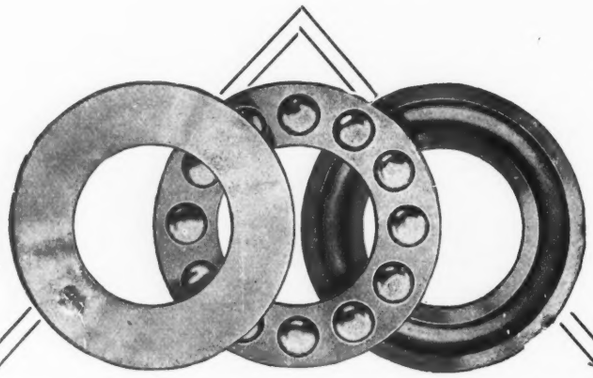
THE WHITNEY MFG. COMPANY

HARTFORD, CONNECTICUT

CHAINS **KEYS AND CUTTERS** **HAND MILLING MACHINES**

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London, Fenwick, Freres & Co., Paris
Rylander & Asplund, Stockholm, Sweden

PLUG THE LEAKS!



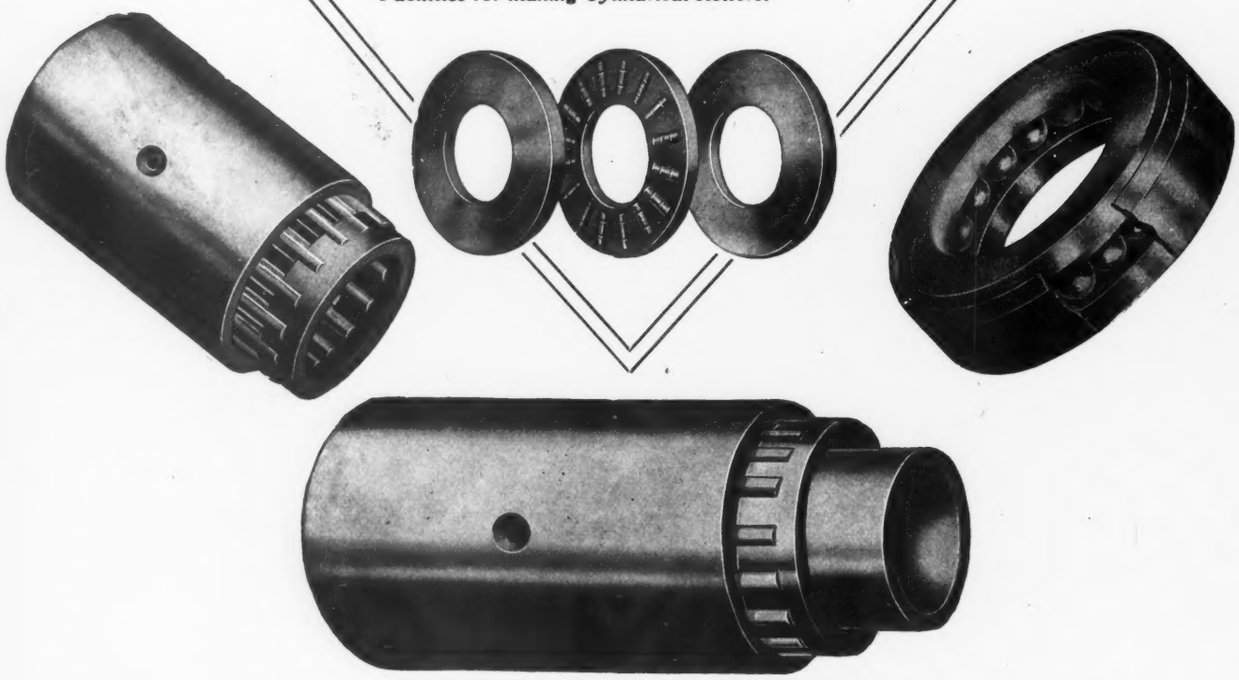
Plug that power leak, stop that profit leak, prevent future leaks. Use *Ball and Roller Bearings* —they are the efficient leak plugs. They cut power costs and stop its waste. They fight friction continuously.

When carefully selected for the purpose, and installed properly in so far as working conditions are considered, *Ball and Roller Bearings* will meet every requirement—this we guarantee. Misjudgment of the need, the when and the where are alone responsible for insufficient service, irrespective of the make of bearing. Know the bearing and you know the service. Let us assist you with your bearing problems—we can save you money. Write us about it.

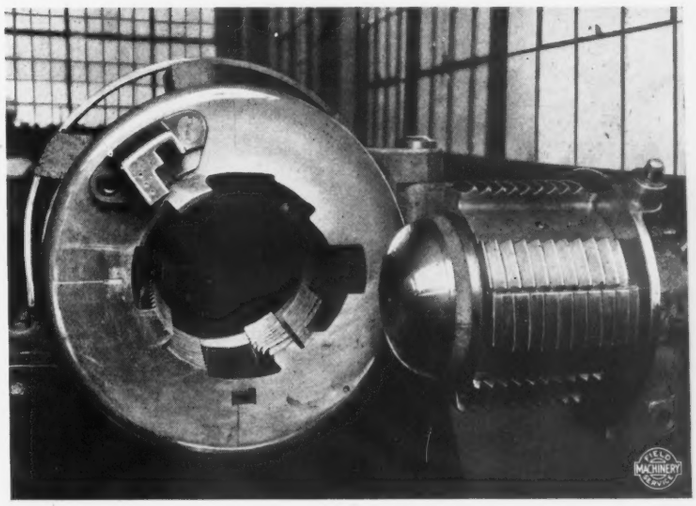
The Ball and Roller Bearing Company

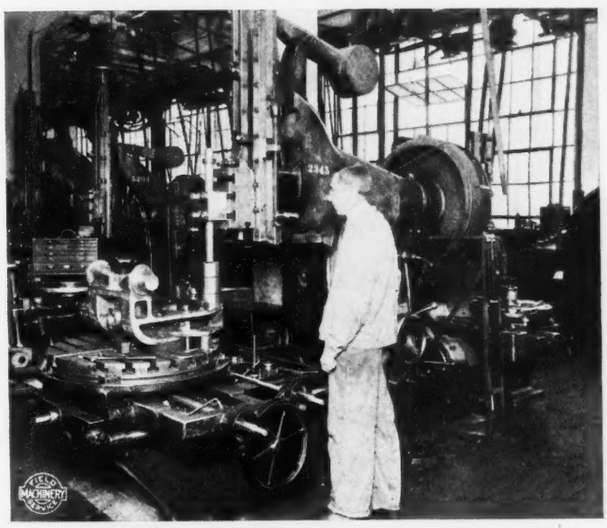
Danbury, Conn., U. S. A.

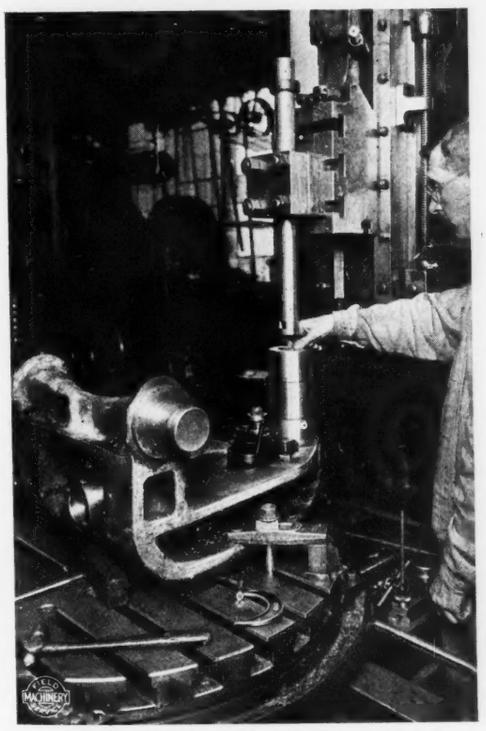
Makers of Radial Roller Bearings, Journal Roller Bearings, Roller Thrust Bearings and Ball End Thrust Bearings (in both inch and millimeter sizes). Unusual Facilities for making Cylindrical Rollers.



DILL SLOTTING Gun Parts







The Dill Slotter shown is cutting a keyway .500" wide by 1/4" deep by 9 1/2" long in a 14" cast steel breech block carrier. Such satisfactory results are obtained that they would rather slot the keyways on the Dill than mill them, which was the method previously used.

The remarkable adaptability of these machines, the high degrees of accuracy obtainable enable them to work to a uniformly high standard of efficiency on a wide variety of work.

There are two Dills in the plant in which these photographs were taken, and adaptability without sacrifice of accuracy helped put them there. The "close up" shows an assembled breach block and ring—the sectors and steps for the step thread are slotted.

A speedy machine, not expensive to operate; rotary table and tilting head make it easy to set up for almost any straight machining operation.

Booklet shows Dill Slotters in operation.
Get it—see what they are doing

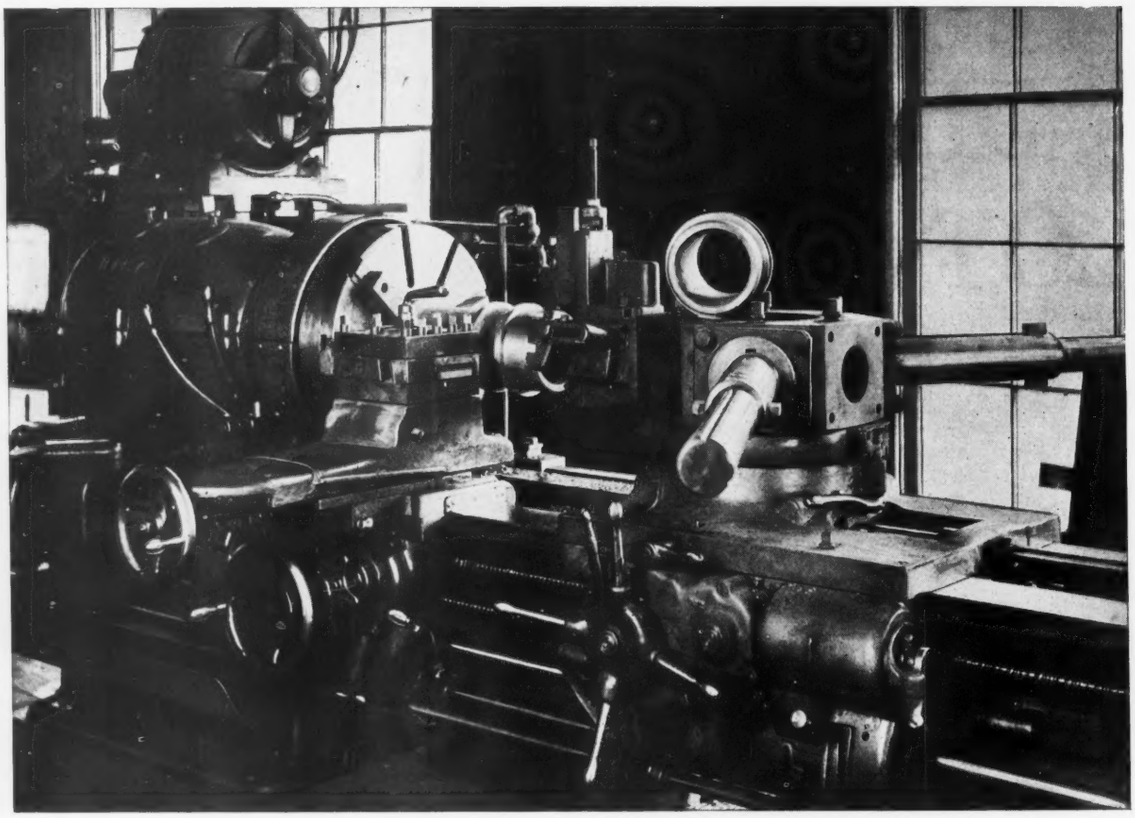
T. C. Dill Machine Co., Inc.

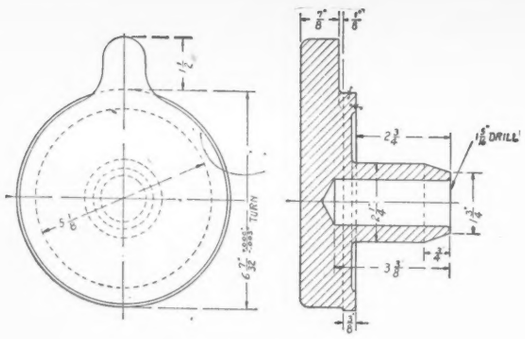
THE DILL SLOTTER PEOPLE

PHILADELPHIA, PA.

DOMESTIC AGENTS: Motch & Merryweather Machinery Co., Cleveland, Detroit and Cincinnati. Mashall & Huschart Machinery Co., Chicago and Indianapolis. Brown & Zortman Machinery Co., Pittsburgh, Pa. W. E. Shipley Machinery Co., Philadelphia.

FOREIGN AGENTS: Alfred Herbert, Ltd., British Isles. Alfred Herbert, Ltd., Yokohama, Japan. Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium. Societe Anonyme, Alfred Herbert, Ltd., Paris, France. Societa Anonima Italiana, Alfred Herbert, Ltd., Milan, Italy.





WATER BOX VALVE CAP

LIBBY LATHES

Saving Over $13.00 Per Hour

Here are facts and figures to show how this Libby Lathe saved $121.80 per day—more than $13.00 an hour for 9 hours. Look at the accompanying sketch. On each water box valve cap the Lucey Manufacturing Corporation, Houston, Texas, saved through this Libby installation 17½c. on labor. In labor plus overhead it saved 43½c. Production is 280 valve caps per day which puts the total saving per lathe at $121.80 or better than $13.00 an hour.

Suppose you could save this sum on your work! Do you know what you do save? Do you save *anything?* Tell us what you make; send blueprints; then, we'll write you. Libby Lathes are built for production and profit—your profit. Write us today.

Leave it to Libby.

INTERNATIONAL MACHINE TOOL CO.

Indianapolis **Indiana, U. S. A.**

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore, Md.; Blackman-Hill-McKee Machinery Co., St. Louis, Mo.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Eccles & Smith Co., San Francisco, Calif., Los Angeles, Calif., Portland, Ore., Seattle, Wash.; E. L. Essley Machinery Co., Chicago, Moline, Ill.; Milwaukee, Wis.; Hill, Clarke & Co., Boston, Mass.; Northern Machinery Co., Minneapolis, Minn.; Seifreat-Woodruff Co., Cincinnati, Ohio, Dayton, Ohio; Strong, Carlisle & Hammond Co., Detroit, Mich., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York, N. Y., New Haven, Conn., Philadelphia, Pa. FOREIGN AGENTS: Andersen, Meyer & Co., Shanghai China; Coats Machinery Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque, Todd & Co., Belgium; Izmosskoff & Co., Petrograd, Russia, Moscow, Ekaterinburg, Russia; V. Lowener, Copenhagen, Denmark, Christiania, Norway, Stockholm, Sweden; Victor B. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France; Mitsui & Co., Japan.

BRUBAKER

REAMERS

Three special features of Brubaker Service make these quality tools particularly popular with up-to-date manufacturers.

First—our advisory service—consultation with our customers on the development of special reamers for unique operations.

Second—the specialized equipment which enables us to guarantee shipment on special reamers within 10 days.

Third—our policy of making reamers to our customers blueprints *at our own risk.*

May we estimate on your special needs?

A large stock of standard reamers on hand for immediate delivery. Send for a Brubaker Catalog.

W. L. BRUBAKER & BROS.
50 CHURCH ST. NEW YORK, N. Y.
Factory at Millersburg, Pa.



BARNES RADIAL DRILL

Spindle Travel 18 inches
No. 4 taper hole in spindle
Weight 3,300 lbs.
Table 24" x 65"

WE illustrate herewith a No. 3 Horizontal Radial Drill or End Drilling and Tapping Machine. The machine is back-geared, strong and well built, and all parts are within easy reach of the operator. The table is slotted for holding the work; the arm is of heavy box pattern, and the sliding head is gibbed strongly on the square ways of the arm. For operating the spindle, the operator has choice of three feeds; namely, the lever feed or the handwheel feed or power feed. Power feed has positive drive.

Dimensions No. 3 Horizontal Drill:

Distance from top of table to center of bearing, 8¾ inches.

Center of bearing to maximum height of spindle, 38¼ inches.

Bearing, 9 by 12 inches long.

Spindle arm moves through circle of 180 degrees.

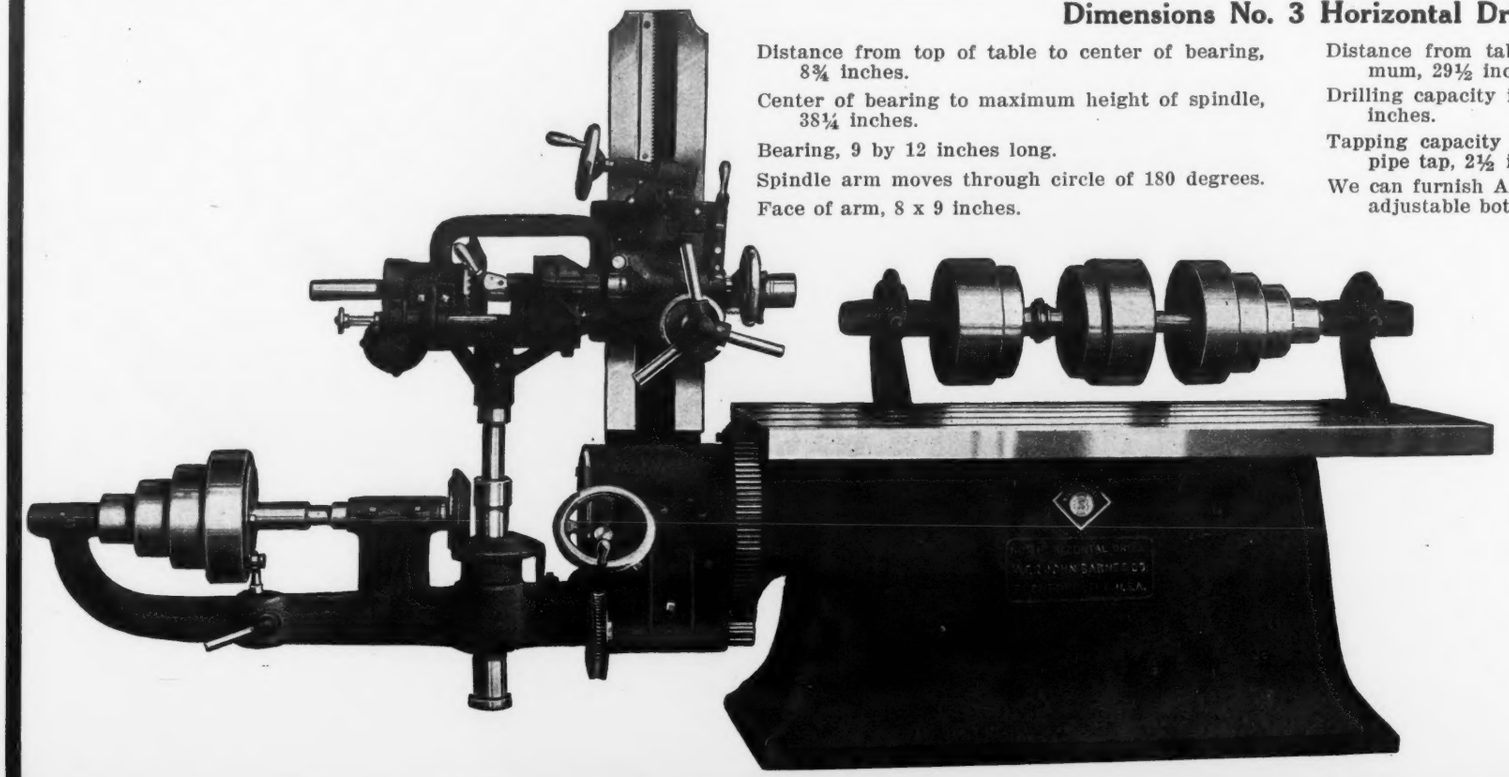
Face of arm, 8 x 9 inches.

Distance from table to center of spindle, maximum, 29½ inches, minimum 2⅜ inches.

Drilling capacity in solid C. I., 3 inches; steel, 2 inches.

Tapping capacity in C. I., 3 inches; capacity of pipe tap, 2½ inches.

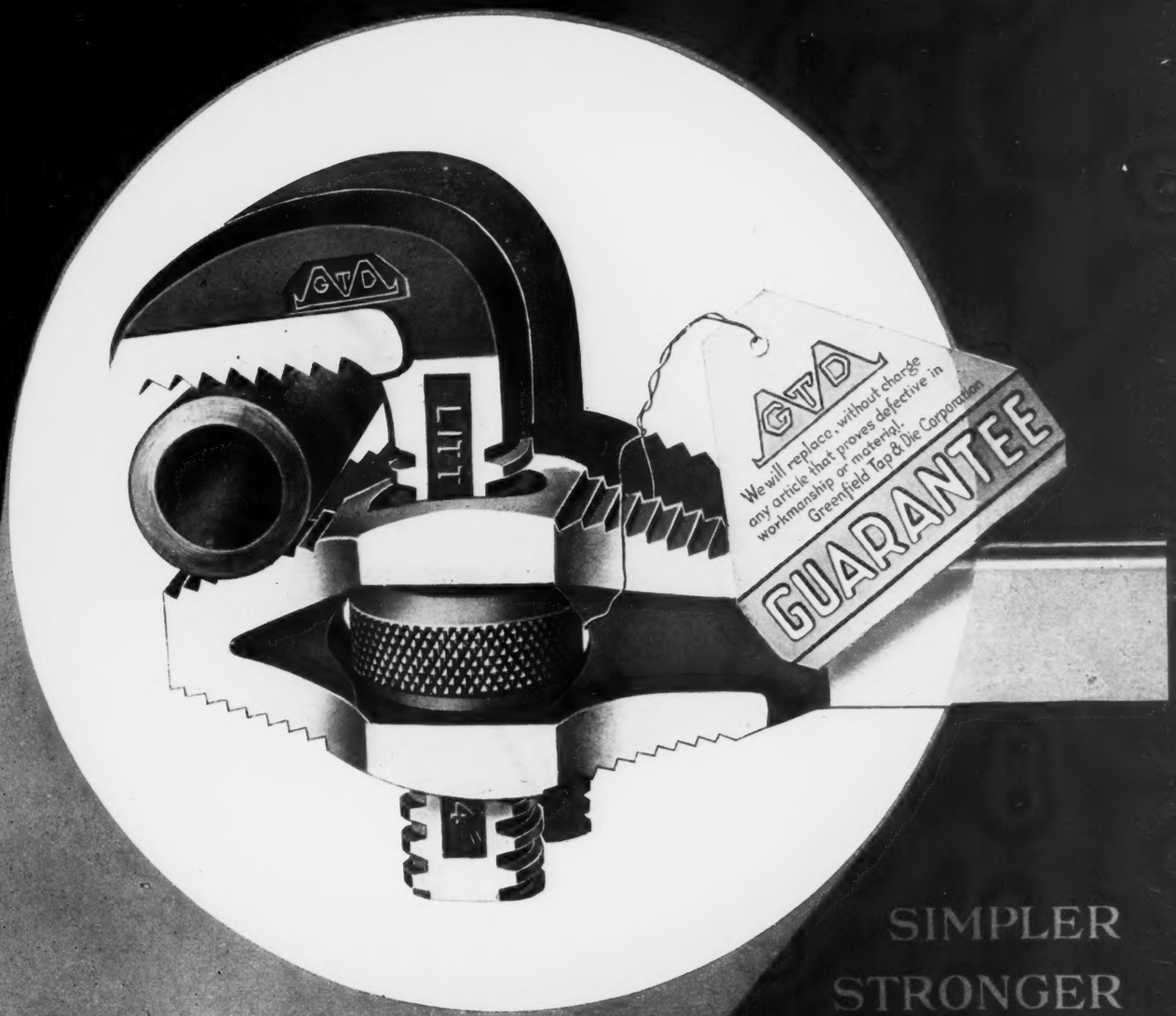
We can furnish Arbor Rest (extra cost) which is adjustable both vertically and horizontally.



W. F. and John Barnes Co.

231 Ruby Street
Rockford
Illinois





SIMPLER
STRONGER
LASTS LONGER
ONLY 3 PARTS

REG. U.S. PAT. OFF.
GTD

THE NEW *Little Giant* PIPE WRENCH

(TURN THE SHEET)



GTD

Introducing the — *Little Giant* PIPE WRENCH

On the Job

It gets into the holes and corners that the conventional pipe wrench can't touch. Look at the *end opening* jaws. They reach into cramped places just like a pair of pliers. They grip instantly and independently of springs.

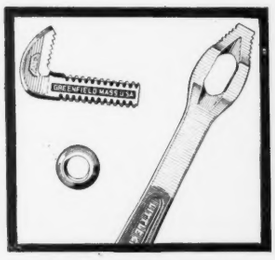
This *"Little Giant"* Wrench *takes hold* and *lets go* quicker than any other wrench you ever used, and we can guarantee that.

The Wrench Itself

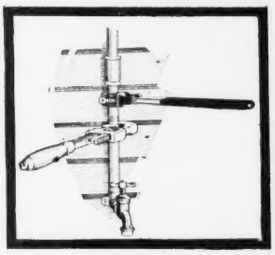
It has just three parts. Two powerful drop forged jaws and a nut, all three carefully heat treated. No cumbersome frame, no springs, no rivets. The new patented design gives extreme strength. (The 14 inch size, for example, has repeatedly withstood stresses in excess of 4700 inch pounds—2800 is Uncle Sam's test.) Finally, it has *double* the life of an ordinary wrench, because the moveable jaw can be engaged with teeth on both sides of the solid jaw. (See illustration)

The *"Little Giant"* Wrench will be made in 8", 10", 14", 18", and 24" sizes. The three smaller sizes are now in stock for immediate delivery. Hundreds of users are daily expressing their satisfaction with this new wrench.

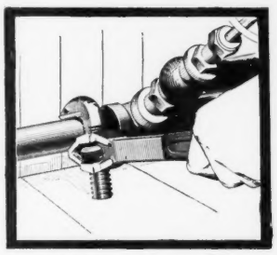
Let us tell you more about it.



ONLY THREE PARTS
Practically Indestructible
(Note teeth on both sides of jaw)



Showing the greater effective swing of the *"Little Giant"* Wrench when pipe is close to wall.



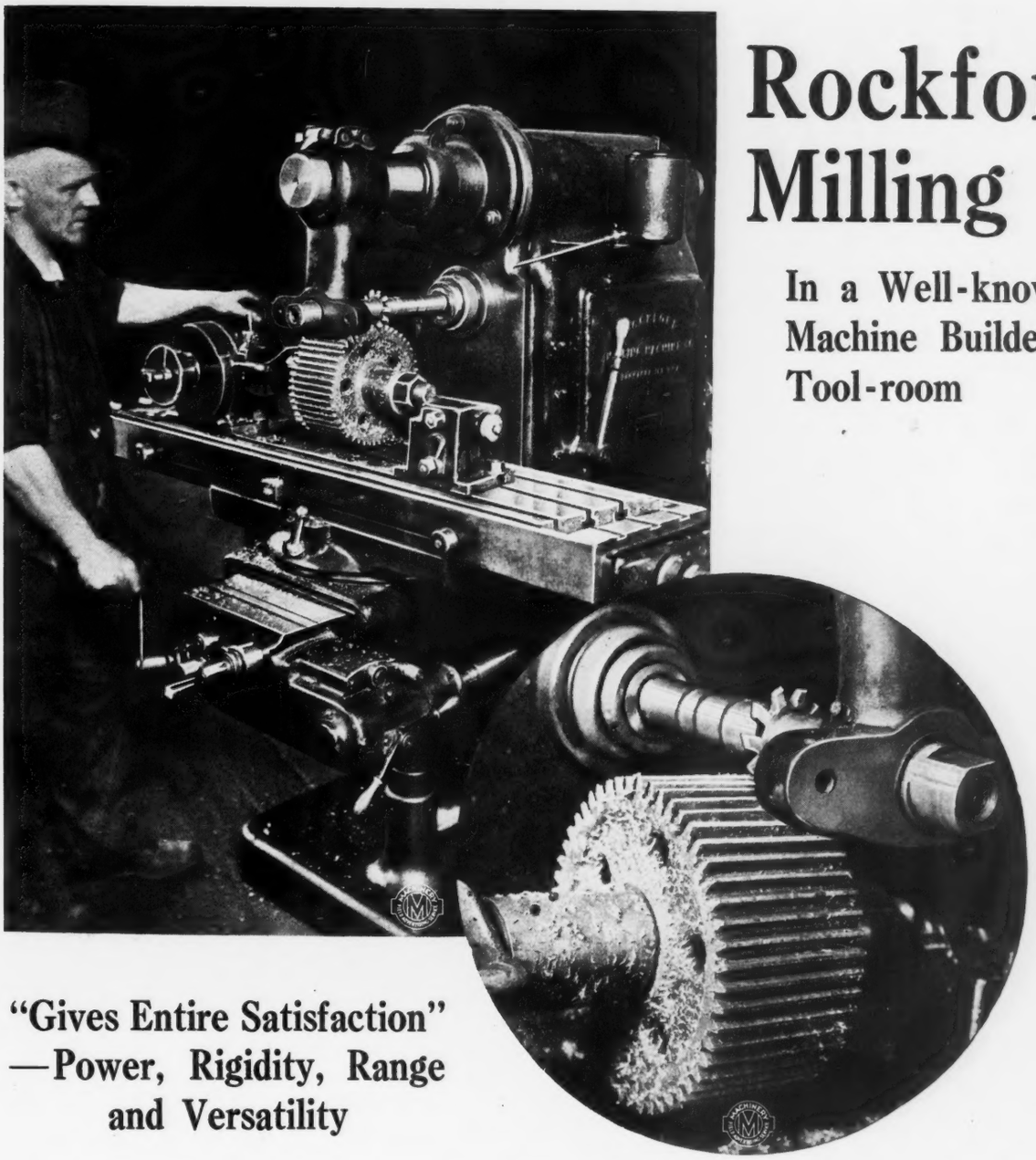
The *"Little Giant"* Wrench being used in a corner.

Mr. Reader:—
This is *not* a "trick" wrench. Hundreds of users have written us that it is the best pipe wrench they ever handled—from every point of view.
You want to know about a tool that lasts twice as long, and takes twice as much punishment—and we want to tell you.
This tag and your letterhead will bring you complete details and prices by return mail.
M.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASS., U.S.A.

GTD SCREW PLATES, TAPS, DIES, TWIST DRILLS
REAMERS, GAGES, PIPE TOOLS, MACHINE TOOLS

NEW YORK: 15 Warren St. CHICAGO: 13 S. Clinton St.
LONDON: 139 Queen Victoria St., London, E.C. 4
CANADIAN FACTORY: Greenfield Tap & Die Corporation of Canada, Ltd., Galt, Ontario



Rockford Milling

In a Well-known Machine Builder's Tool-room

"Gives Entire Satisfaction" —Power, Rigidity, Range and Versatility

The Universal Machine & Tool Company, Canton, Ohio, uses the Rockford Milling Machine shown for anything and everything requiring accuracy. Its Vertical and Slotting Attachments—adjustable to full 360°—and ample, well-supported table permit handling odd jobs of all kinds; and the rigidity with which the overhanging steel arm holds and drives the cutters eliminates all danger of chatter.

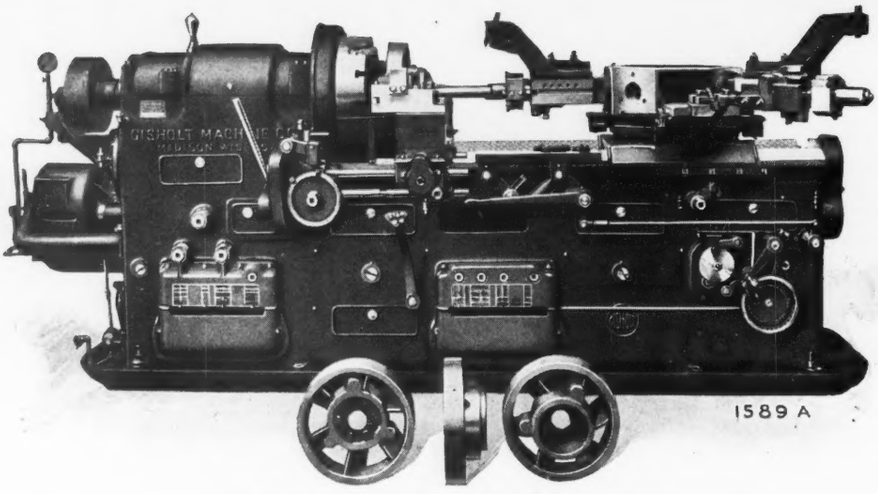
When photographed, the machine was being used to cut accurately spaced teeth in some very particular gears. The work is chucked between centers of the Rockford Universal Dividing Head for indexing and a form cutter finishes the teeth—clean, straight and smooth. Let us describe this machine.

ROCKFORD MILLING MACHINE COMPANY

ROCKFORD, ILLINOIS, U. S. A.

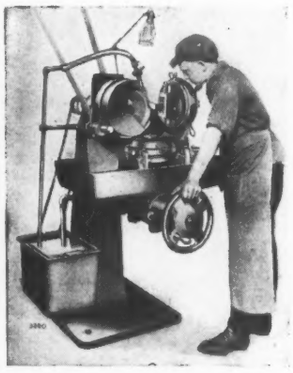
REPRESENTATIVES: Aumen Machinery Co., 107 E. Lombard St., Baltimore, Md.; W. J. Baird Machinery Co., Jefferson Ave. and Brush Street, Detroit, Mich.; Dale Machinery Co., Inc., 541-547 Washington Blvd., Chicago, Ill.; Dale Mchy. Co., Inc., 17 East 42nd St., New York City; English Tool & Supply Co., 5th and Washington Sts., Kansas City, Mo.; Greensboro Supply Co., Greensboro, N. C.; Herberts Mchy. & Supply Co., Third and San Pedro Sts., Los Angeles, Cal.; Herberts Mchy & Supply Co., 140 First St., San Francisco, Cal.; The Hess-Schenck Co., Cleveland, O.; Wm. C. Johnson & Sons Machinery Co., 1001 North 6th St., St. Louis, Mo.; M. D. Larkin Supply Company, 501-503 East Third Street, Dayton, Ohio; Lynd-Farquhar Company, 419 Atlantic Ave., Boston, Mass.; McMullen Machinery Co., 64-66 Ionia Ave., S. W., Grand Rapids, Mich.; Mid-West Machine & Tool Supply Co., 321 East 4th St., Davenport, Iowa; Monarch Machinery Co., 300 North Third Street, Philadelphia, Pa.; Peden Iron & Steel Company, Houston, Texas; F. E. Satterlee Company, 118 Washington Avenue, North, Minneapolis, Minn.; William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa.; Homer Strong & Co., Inc., 301 State St., Rochester, N. Y.; Charles A. Strelinger Co., Ltd., Windsor, Ont; Sunderland Machinery & Supply Co., Omaha, Neb.; C. H. Wood Co., 214-216 West Jefferson St., Syracuse, N. Y.; Yeates Machinery Supply Co., 16 Cathcart St., Montreal, Que.; Young & Vann Supply Company, Birmingham, Ala.

GISHOLT



20-INCH AUTOMATIC TURRET LATHE

One of two Automatic Turret Lathes, operated by one man, which replaced two hand lathes, operated by two men. Besides saving labor, the Automatics increased the production 10 wheels a day, and improved the accuracy of the product.



UNIVERSAL TOOL GRINDER
For sharpening single point cutting tools

In addition to heavy machine tools, we also manufacture small tools, such as Solid Adjustable Reamers, Boring Bars, Tool Holders, and Chucks.

To assist users of Gisholt machines in getting the greatest results from them we conduct an intensified course of training called the Gisholt School.

Don't you think it would be worth while to ask us for more information on any of these subjects—they are universally instrumental in cutting costs.



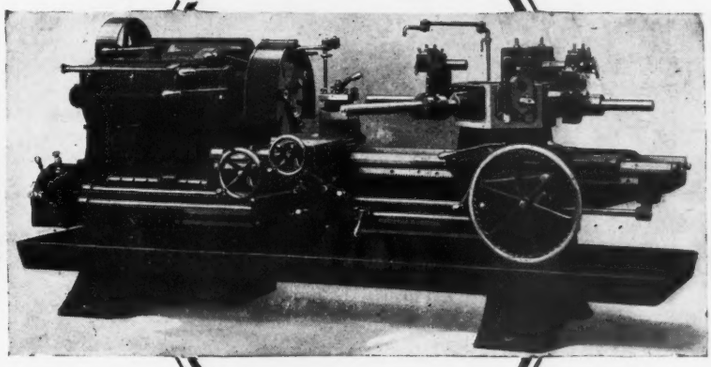
STANDARD TURRET LATHE
Made in six sizes, 13 inch to 41 inch

GISHOLT MACHINE COMPANY

General Offices: 9 S. Baldwin Street, Madison, Wisconsin
Eastern Sales Office: 30 Church Street, New York City
Works: Madison, Wisconsin; Warren, Pa.

AGENTS: Atlanta, Ga., Seeger Machine Tool Co.; Buffalo, N. Y., J. L. Osgood Tool Co.; Chattanooga, Tenn., James Supply Co.; Chicago, Ill., Stocker-Rumely-Wachs Co.; Denver, Colo., Hendrie & Bolthoff Mfg. & Supply Co.; Detroit, Mich., Charles A. Strelinger Co.; Indianapolis, Ind., Vonnegut Machinery Co.; Herberts Mchy. & Supply Co., Los Angeles and San Francisco, Cal.; New Orleans, La., P. H. McArdle, Philadelphia, Pa., Swind Mchy. Co.; Portland, Ore., Portland Mchy. Co., St. Louis, Mo., Colcord-Wright Mchy. & Supply Co.; Minneapolis, St. Paul, Minn., Savage & Winter Co.; Salt Lake City, Utah, Salt Lake City Hardware Co.; Seattle, Wash., Perine Machinery Co. CANADA: Canadian Fairbanks-Morse Co., Calgary Hamilton, Montreal, Ottawa, Quebec, St. John, Toronto, Vancouver, Winnipeg.

FOREIGN AGENTS: Australia, Benson Bros., Sydney, Melbourne; Belgium, Atteliers Demoor, Brussels; British Isles, Burton, Griffiths & Co., London, Birmingham, Manchester and Glasgow, Scotland; France, Aux Forges de Vulcain, Paris; Italy, Emanuele Mashcherpa, Milan; Japan, Andrews & George, Tokyo; Norway, Union Machine Co., Christiania; Sweden, Axel Ryden, Stockholm; Switzerland, J. Lambercier & Co., Geneva.



This paragraph from Andrew Carnegie's Autobiography applies more today than when he said it.

IT is surprising how few men appreciate the enormous dividends derivable from investment in their own business.

There is scarcely a manufacturer in the world who has not in his works some machinery that should be thrown out and replaced by improved appliances; or who does not for the want of additional machinery or new methods lose more than sufficient to pay the largest dividend obtainable by investment beyond his own domain. And yet most business men whom I have known invest in bank shares and in far-away enterprises, while the true gold mine lies right in their own factories."

Warner & Swasey Turret Lathes will prove a veritable "gold mine" in your shop whether they replace out-of-date tools or start you off right on your new lines of work. Follow Mr. Carnegie's advice and send us your blue prints for a definite report of what dividends they pay.

The Warner & Swasey Company

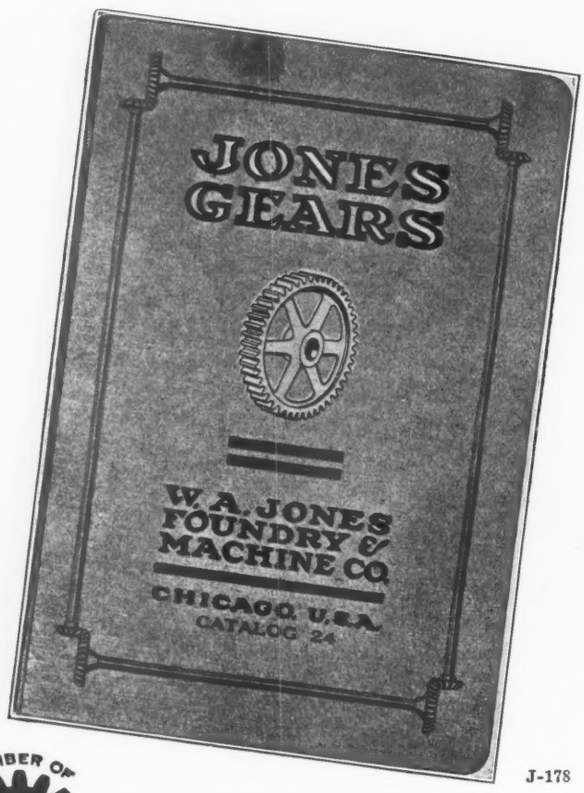
Cleveland, U. S. A.

NEW YORK: Singer Building
CHICAGO: 618-622 Washington Boulevard
MILWAUKEE: 209 Sycamore Building
BOSTON: Oliver Building
INDIANAPOLIS: 940 Lemcke Annex
BUFFALO: Iroquois Building
DETROIT: 5928 Second Boulevard
DAYTON: 518 Mutual Home Building

A NEW CATALOG

ON

Jones GEARS



J-178

This new JONES catalog lists a most complete line of cast-tooth gear patterns—Spur gears—bevel gears—mitre gears—worm gears—racks and pinions.

It also contains list prices for Rawhide Pinions as well as miscellaneous information useful when laying out gear drives or for estimating purposes. Net prices for all sorts of cut or cast gears will be quoted on application.

Send for your copy of this new JONES GEAR book TODAY.

MEMBER OF AGMA

W. A. JONES FOUNDRY & MACHINE COMPANY

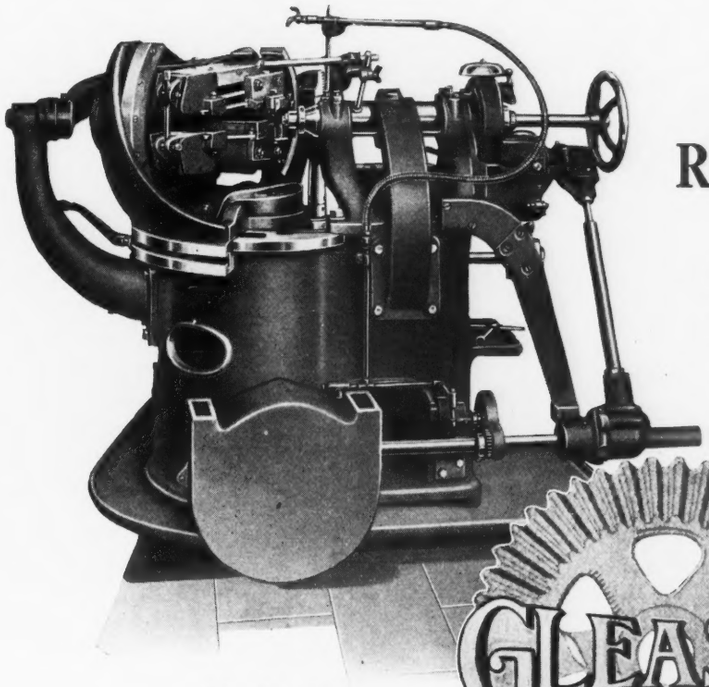
MAIN OFFICE AND FACTORIES

4409 WEST ROOSEVELT ROAD, CHICAGO

BRANCH SALES AND ENGINEERING OFFICES:

NEW YORK, N. Y.	PITTSBURGH, PA.	BUFFALO, N. Y.	MILWAUKEE, WIS.
26 Murray Street	Union Arcade	184 Main St.	First Wisc. Nat. Bk. Bldg.

GLEASON
BEVEL GEAR GENERATORS



6 in. Generator

Are Built for Rapid Production

Made in Capacities From 3" to 25"

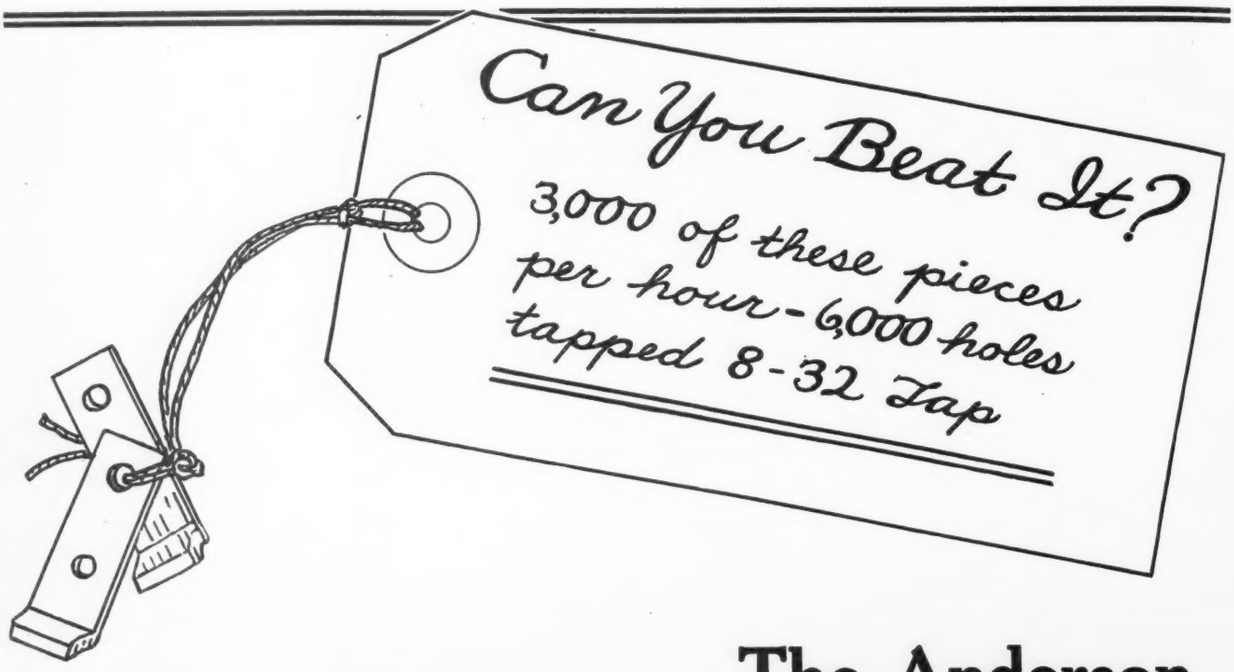


The speed at which gears are produced on these machines makes the unit cost of correctly generated gears very moderate.

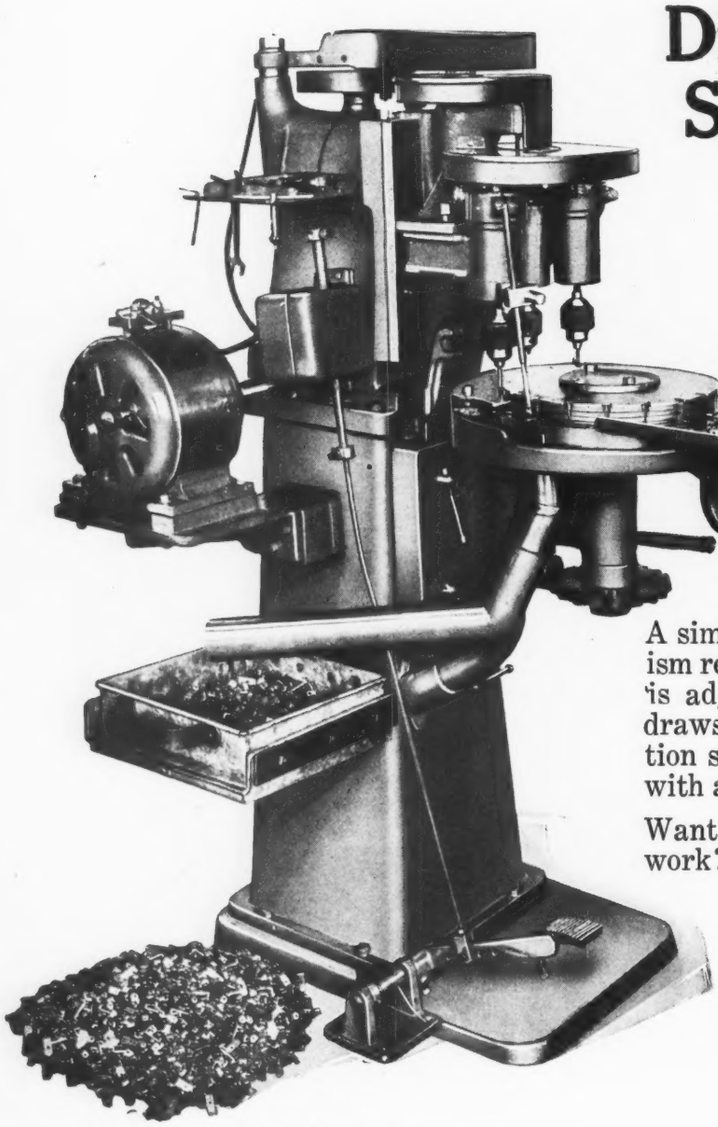
Let us give you production estimates.

Gleason Works
Rochester, N. Y.

3 in. Generator



The Anderson Dial Feed Multiple Spindle Tapping Machine



If these pieces had three holes each and every thread different—output would be just the same; and with only one hole output could be doubled by doubling the number of slots in the dial.

A simple segment and pinion drive mechanism replaces the ordinary clutch and reverse, is adjustable for depth of hole and withdraws taps at twice tapping speed. Operation somewhat resembles a punch press fed with a dial and requires no special skill.

Want more details and estimates on your work? Write us.

THE ANDERSON DIE MACHINE COMPANY

BRIDGEPORT, CONN.



Quality All Through

The "Liberty" is also made in standard types, motor or belt drive, sizes 22″ to 60″. Circulars on either or both machines on request.

For big, awkward pieces, work that overhangs the planer table, odd shaped castings —there is nothing like an Open-Side Planer.

In all lines of machine work the need for the "Open-Side" comes up—the photo shows a "Liberty" making good in the Improved Paper Machinery Company's plant at Nashua, N. H.—been making good for over a year and saving time and labor in planing the frames and housings for paper pulp machinery. Only one instance where the Liberty Open-Side helped—we have a long list of installations in other lines of manufacture we'd like to show you.

LIBERTY MACHINE TOOLS

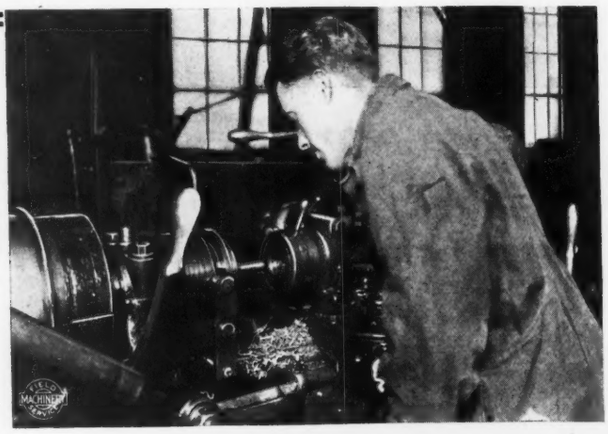
LIBERTY MACHINE TOOL COMPANY

HAMILTON OHIO, U. S. A.

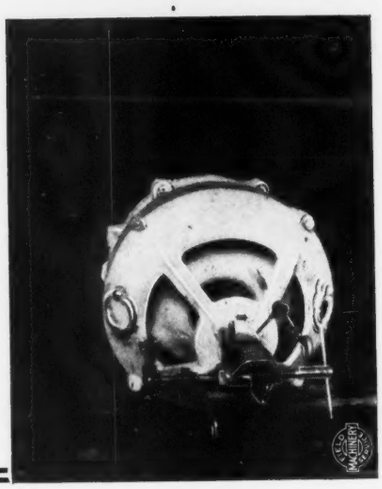
Hartness Die Heads

Sturdy Tools

At the White Fuel Oil Engineering Company's plant, in New York, small lots of threading, or "fill in jobs," are invariably handled by one of this company's large installation of Hartness Die Heads—not only because these tools are quick and accurate, but because they can be rapidly changed from one set-up to another and are ruggedly built to stand frequent changes. The operation shown is a burner housing screw for an oil burner to be used under a marine steam boiler.



Hartness Die Heads are standard equipment in practically every industry. Let us tell you all about them.



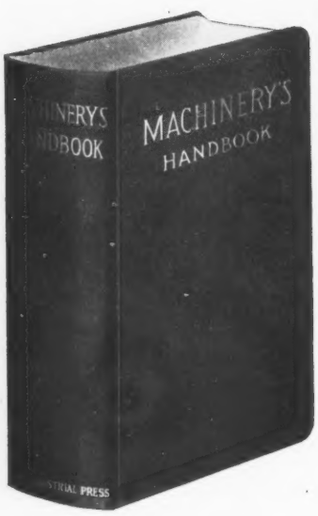
JONES & LAMSON MACHINE COMPANY

DIE DIVISION, SPRINGFIELD, VERMONT, U. S. A.

Write for list of American and Foreign Agents

503 Market Street
SAN FRANCISCO, CAL.

9-10 Water Lane
Queen Victoria Street
LONDON, ENG.



THIS IS THE BOOK—

"You have the Answer if You have the Handbook"

It is the standard mechanical handbook that covers thoroughly the field of machine shop practice, machine and tool design from the practical point of view. MACHINERY'S HANDBOOK contains in its 1400 pages every essential fact, figure and table needed in machine shop and drafting room. It is the working reference book of a great trade.

The coupon below brings a copy of MACHINERY'S HANDBOOK for your inspection free for ten days. Use its tables and formulas to solve your shop problems. See how thoroughly it covers every branch of your work. If you do not want to keep it, return it to us at our expense. You are under no obligation to buy.

A standard reference book for draftsmen, foremen, toolmakers, designers, superintendents, machinists and mechanical engineers.

Sold on small monthly payments

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THE INDUSTRIAL PRESS,
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You may send me for my free inspection a copy of MACHINERY'S HANDBOOK. I enclose $2.00 which is refunded me if I return the book to you at the end of ten days. Or, if I wish to keep the book, I will send you $2.00 a month for two months, paying in full the price of only $6.00.

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Sent on approval in U. S. and Canada

8-22

Johansson
ACCURACY

Checking the Manufacturing Operations



The Story of Johansson Gages and Garvin's New Grinder

We told the beginning of the story of Bright Internal Grinders in our last month's advertisement; showed how the tools, jigs and fixtures used in their manufacture were checked to standards set with Johansson Gages. Here we show steps in the manufacture of the machine itself.

By checking at each step with the correct Johansson Gage complete interchangeability is obtained.

The upper photograph shows the checking of the main work spindle (3″ diameter, held to limit of —.0002 + .0000) with a Johansson Snap Gage. In the other the operator is checking the diameter of the cast iron frame for the motor which drives the wheel spindle, with a Johansson Double End Adjustable Plug Gage.

The third chapter in this story of "commercialized accuracy" will be printed next month and will show Johansson Gages checking the finished machine and its work.

There's a Johansson Gage to check every operation. Let us show you how to reduce manufacturing costs by maintaining Johansson standards.

Write for the story of Johansson Gages.

C·E·Johansson·Inc
POUGHKEEPSIE · N·Y

Cutting the Cost of Drilling



The one way to reduce your drilling costs is to buy the drill that will give you the greatest number of holes per dollar.

In all lines of manufacture Detroit Twist Drills have demonstrated their ability to give more accurate holes with less re-grinding and less cost of power.

In the complete Detroit Twist Drill Company line you will find a convenient and unusually satisfactory source of supply for all your small tool requirements. This includes Detroit Twist Drills, both carbon and high speed; reamers; cutters and end mills; counterbores and miscellaneous small tools—in addition to the Double D Drill, the marvel drill which is "Hot Rolled" of high tungsten, high-speed steel—now available in all sizes including the small sizes 1/4 to 1 5/8 inches.

Your inquiries will have prompt attention.

DETROIT TWIST DRILL CO., Detroit, Michigan

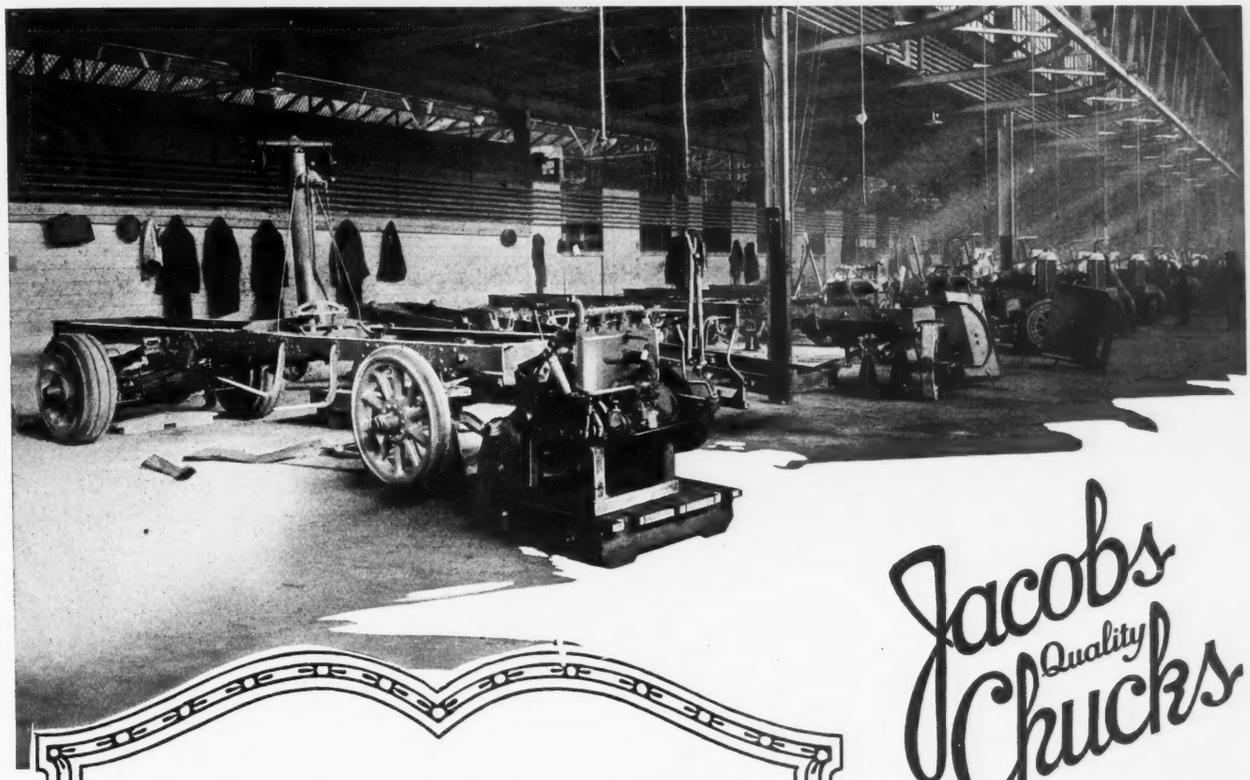
45 Warren St., New York **Hurt Bldg., Atlanta**

Canadian Detroit Twist Drill Co. Ltd., Walkerville, Ont.

31

DETROIT TWIST DRILLS

REAMERS, CUTTERS AND SPECIAL TOOLS



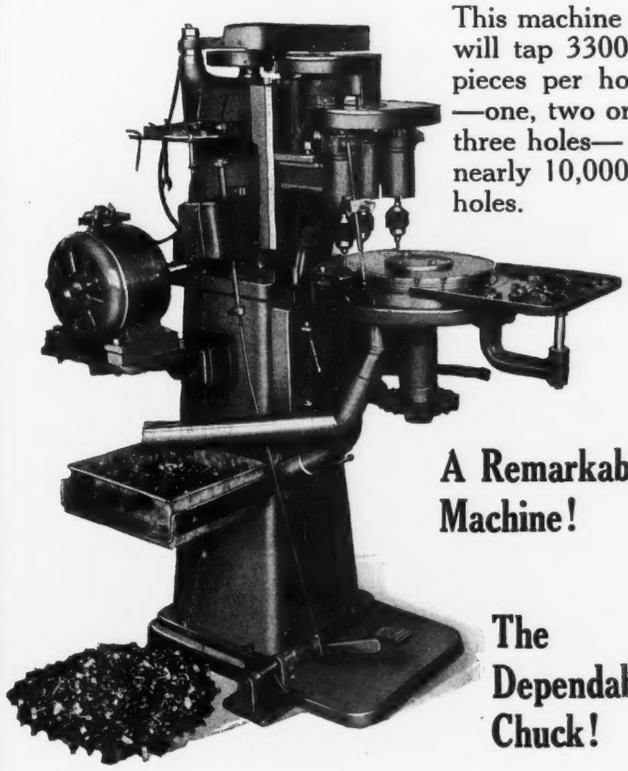
Jacobs Quality Chucks



The Business End of Good Tapping Equipment

When the Anderson Die Machine Company, Bridgeport, Conn., developed its new Dial-feed Multiple Spindle Tapping Machine the natural selection for chuck equipment was the "Jacobs."

This machine will tap 3300 pieces per hour —one, two or three holes— nearly 10,000 holes.



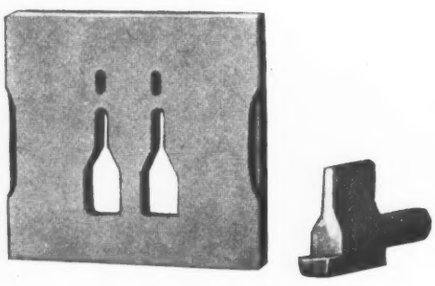
A Remarkable Machine!

The Dependable Chuck!



Designed by MACHINERY

Vulcan Special Vanadium



This Die to the left

Blanked out 29,957

* * *

Saws—24 strokes per saw

* * *

Which means that

* * *

It punched through 1 1/3

* * *

MILES of 1/00% Carbon Steel.

* * *

Even then it was not

* * *

Worn out. The Die

* * *

Would have plowed through

* * *

More 11 gauge stock, but

* * *

It was then too thin

* * *

To be held in the press.

* * *

VULCAN SPECIAL VANADIUM Tool Steel

* * *

Does this kind of work.

VULCAN CRUCIBLE STEEL COMPANY

Home Office and Works: ALIQUIPPA, PA.

Established 1900 *Makers of Vulcan Special Vanadium*

Branches:—New York, Chicago, Detroit, Boston and St. Louis



Speeds Locomotive Repairs

"..... this machine" said the foreman of the D. L. & W. Shops at Hoboken, N. J., "has handled satisfactorily every job we've given it." They use it to special advantage in roughing out wrist pins, knuckle pins, etc., from second hand engine truck axles. The unusually large size hollow head stock spindle which enables them to run a bar of tubing through and bore and cut off bushings at one setting secures great speed on this work.

The job shown—turning down one-half a worn out locomotive axle into knuckle pins—is a pretty tough proposition. The axle, high carbon steel, further toughened by miles of service under a locomotive, is 6½" diameter; the pins are 4" in the largest diameter. The photograph shows the roughing cut taking off a chip 1¼" deep while the work revolves at the rate of approximately 36 feet per minute. A husky chip—a deep cut that is taken easily and without strain.

It's the kind of work the foreman meant when he made the remark we've quoted.

Versatile, speedy, convenient and POWERFUL—A copy of Bulletin 1301 will give you specifications and details of Ryerson-Conradson Lathes.

JOSEPH T. RYERSON & SON

Established 1842 Incorporated 1888

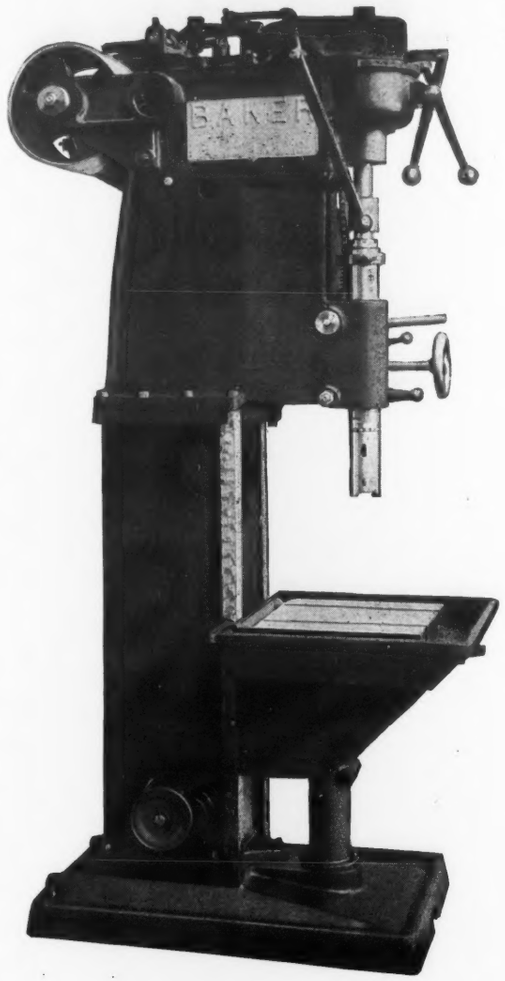
Plants:

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Offices:

MINNEAPOLIS MILWAUKEE DENVER HOUSTON SAN FRANCISCO

RYERSON MACHINERY

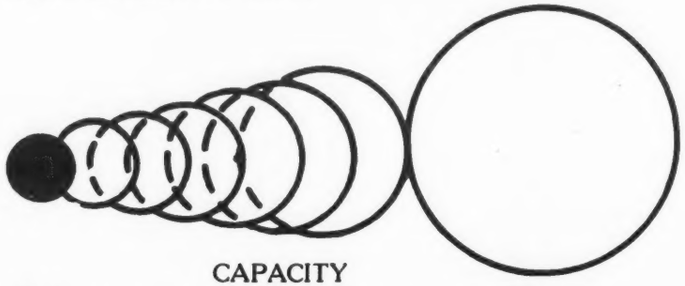


Do You Drill from 3/8" to 1½"?

if so, the

BAKER 121

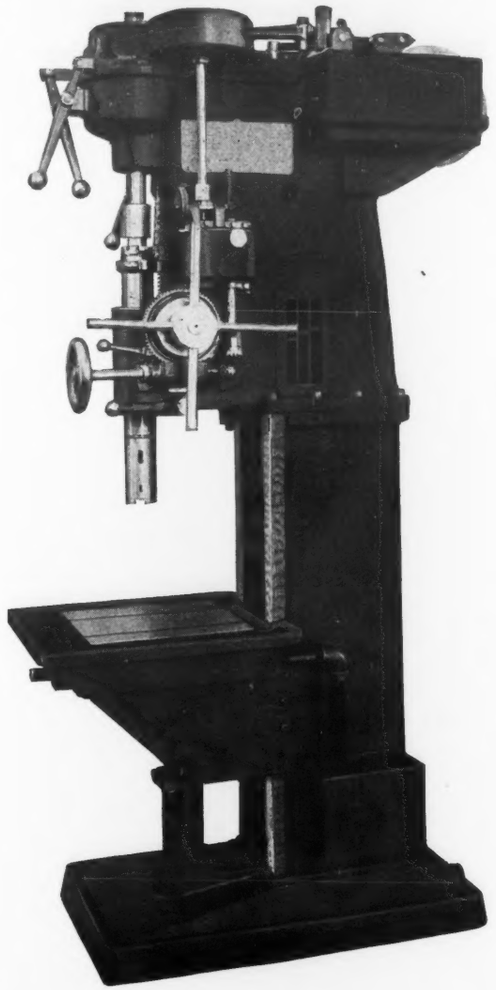
Light-Heavy Duty Drilling and Boring Machine will prove an exceedingly profitable investment for you. This machine meets the needs of a high-grade simple tool for drilling operations from 3/8" to 1 1/2" yet is as easily and quickly handled as a light sensitive drill.



CAPACITY

3/8" - - - - To - - - - 1½"

Furnished either as a quick change or single purpose type, in single units, or two, three, and four spindle gangs. A remarkably wide combination of speeds and feeds available.

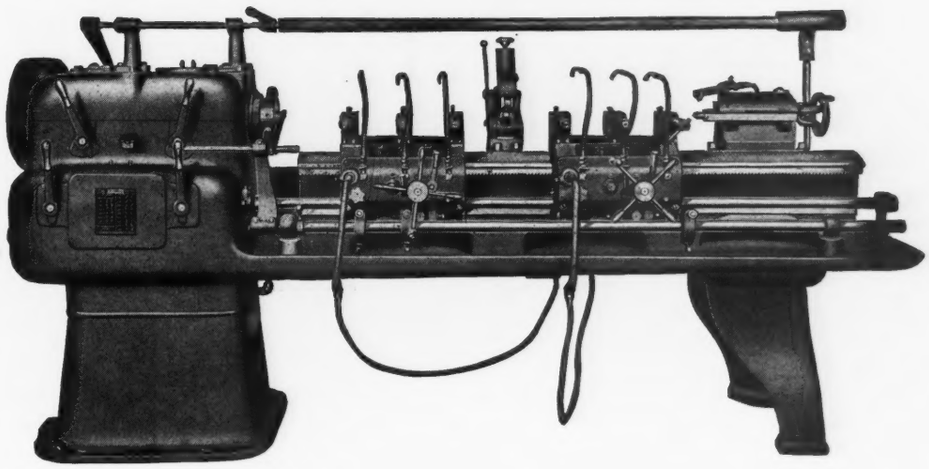


Write us for details concerning many interesting features on this machine and let us show you what an installation will do on your work.

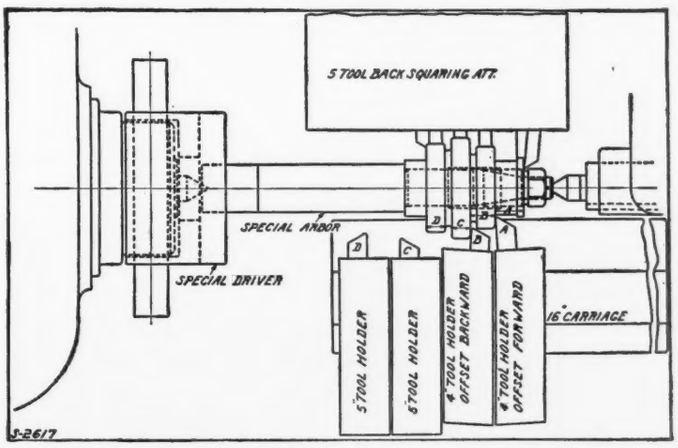
BAKER BROTHERS, Toledo, Ohio, U. S. A.

Lo-swing

Multiple Tooled for Speed and Accuracy



This is the 4″ *Lo-swing* Lathe. The drawing shows how one machinery manufacturer profitably uses its production possibilities in the manufacture of cluster gears. They are finished from the rough stock in one setting by tools working simultaneously from the back and front of the machine.

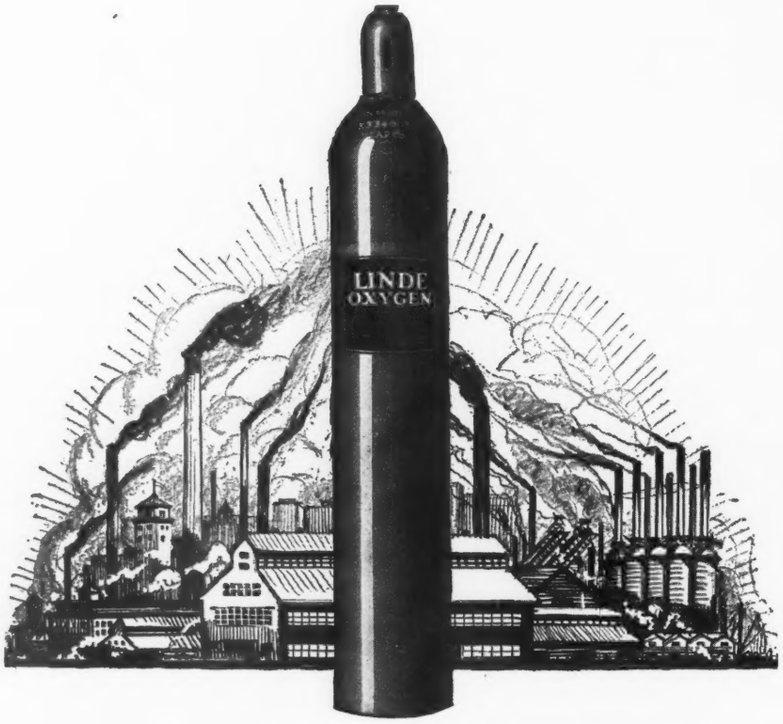


An efficient, accurate piece of work that is an interesting illustration of the commercial value of concentrated effort.

Send for the details of these production machines and drawings of other operations.

Fitchburg Machine Works, Fitchburg, Mass.

REPRESENTATIVES: Detroit and Cleveland District, W. H. Nettle, 236 Richton Ave., Highland Park, Detroit, Mich. Chicago, Milwaukee and St. Louis District, W. A. McCarrell, 429 Kenwood Boulevard, Milwaukee, Wis. Southern Continental Europe, G. E. Fogarty, 42 Rue de Peletier, Paris 9e, France. Northern Continental Europe, O. Ericsson, Axelborg, Copenhagen B, Denmark. British Isles, Buck & Hickman, Ltd., 2 and 4 Whitechapel Road, London E 1, England.

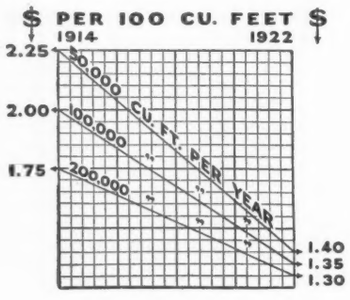


A Policy and Its Results

In 1914 when the oxygen industry was in the early stages of development the LINDE COMPANY adopted as two important features of its sales policy:

First: A definite schedule of prices based on consumption.

Second: A reduction of prices as rapidly as increased volume warranted.



The accompanying chart shows typical prices applying in 1914 as compared with those applying under our new 1922 schedule. This illustrates clearly the benefits to LINDE users of the continued application of these two features to the large increase in production since 1914.

The 1922 prices shown for the respective consumptions are the average for the entire chain of 30 plants and 50 warehouses through which LINDE OXYGEN is distributed today. Slightly lower prices prevail at the plants in districts of heavy oxygen demand. Higher prices prevail where shipments are made from convenient service warehouses, or where undeveloped consumption does not permit large scale plant production and distribution.

No oxygen user, large or small, should close an arrangement for oxygen supply without first securing 1922 prices from the nearest LINDE District Sales Office.

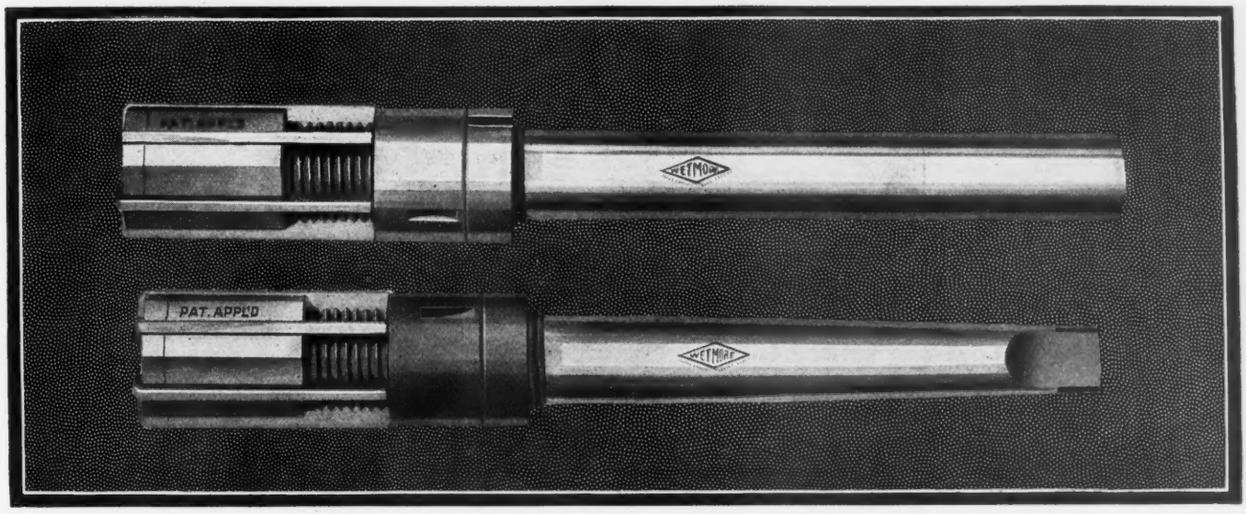
THE LINDE AIR PRODUCTS COMPANY

Carbide and Carbon Building, 30 East 42nd Street, New York

District Sales Offices in these cities: *Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dallas, Detroit, Kansas City, Mo., Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco*

THE LARGEST PRODUCER OF OXYGEN IN THE WORLD

2281-22



At Last! A Guaranteed Machine Reamer
—in Sizes *Under One Inch*

Last February we announced the perfection of Wetmore Expanding Machine Reamers—all sizes under one inch. Their reception by manufacturers was immediate. They filled a long-felt want. Since February, we have been kept busy supplying the demand for these small reamers of *guaranteed quality and accuracy.*

These new Wetmore Expanding Small Machine Reamers range in size by thirty-seconds from 5/8" to 31/32", inclusive—both straight and taper shank. In expanding these small reamers, there are no unnecessary screws to be loosened, because the expansion is taken care of by a cone nut and lock nut in rear of blades. The straight blades are held securely by a special method, exclusive to Wetmore Expanding Reamers.

These Wetmore "little fellows" typify the high standards of workmanship and materials that have made Wetmores *standard* in so many of America's largest plants. Here are some of the advantages of the general line of Wetmore Expanding Reamers:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering, and scoring of the reamer while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

Write for your copy of the Wetmore Hand-book—a valuable reference work for precision tool users. Sent free, postpaid, on request.

Wetmore Reamer Company

60-64 27th Street **Milwaukee, Wisconsin**

Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors, Blades and Thread Gauges

REPRESENTATIVES

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New York, N. Y.

Devlin Supply Company,
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Mr. E. E. Ehrenfeld,
444 Little Building,
Boston, Mass.

Kemp Machinery Co.,
215 North Clavert Street,
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The W. Bingham Company,
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625-29 Seventh Street,
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The E. A. Kinsey Company,
Indianapolis, Indiana.

Wyman-Taylor-Ward Co.,
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The R. C. Neal Company,
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R. H. Jones Company,
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WETMORE EXPANDING REAMERS

"THE BETTER REAMER"



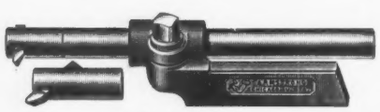
CUT
CUTTING
COSTS

ARMSTRONG TOOL HOLDERS

Armstrong Tool Holders are used in nearly all machine shops and are one item of equipment which you can actually **SEE** saving money for the owner.



Turning and Shaper Tool



Boring Tool



Right Hand Side Tool

SAVE

High Speed Steel Time

Grinding Wheels

—

Increase Production

—

Specify ARMSTRONG

—

Catalog free



Left Hand Cut-off Tool



Threading Tool



Planer and Shaper Tool

ARMSTRONG BROS. TOOL CO.

"THE TOOL HOLDER PEOPLE"

313 N. FRANCISCO AVE. CHICAGO, U.S.A.

AJAX

(Trade Mark Registered)







WELDLESS Bottom Connections at Rate of 300 per 9 Hours

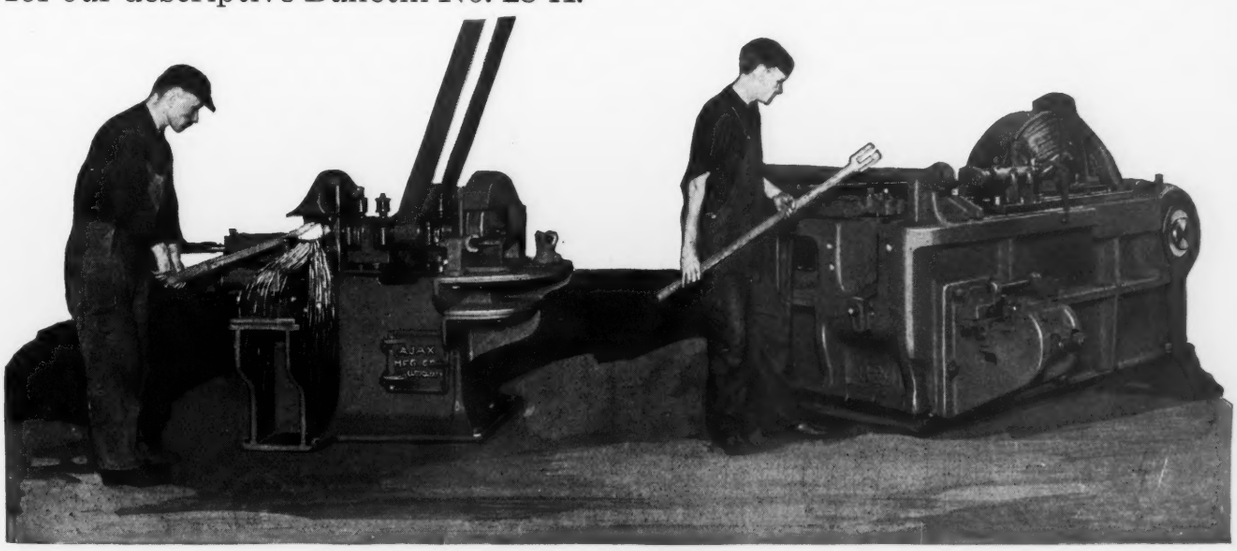
Weldless Bottom Connections are being produced by an Ajax Upsetting Forging Machine and Ajax Hot Saw more rapidly and economically than the inferior welded rods.

Bottom connections have been made for years by welding forged jaws or "U" pieces onto rods of the required length. Production seldom exceeds 125 or 150 complete rods per day and defective welds cause frequent breakages.

Weldless bottom connections are, as the name implies, made from one solid bar of steel of the required size without weld. The stock used is brought to good forging heat on the end and given a preliminary upset A in the forging machine. It is then passed to the hot saw for slitting B and returned to the forging machine, where the jaw is formed in a single operation. All this is done without re-heating.

A crew of three men produce more than 600 ends, i. e., 300 complete weldless rods, in a 9-hour day without difficulty, ***cutting the labor cost in two and yet giving a superior product.***

For producing jaws and "T" head forgings the Ajax Hot Saw and Burring Machine is a most valuable auxiliary to the Upsetting Forging Machine. Write for our descriptive Bulletin No. 28-A.



THE AJAX MANUFACTURING CO.

621 Marquette Building
CHICAGO, ILL.

CLEVELAND, OHIO

1369 Hudson Terminal
NEW YORK CITY

Put the COGSDRILL to Work on Your Centering Operations



Methods of Forming and Machines Patented

Decrease the breakage commonly known in Centerdrills

Eliminate the needless waste of time stopping to change Centerdrills.

Giving you a true Countersunk hole which insures accurate finishing operations.

Let us convince you. Catalogue No. 2 for the asking

COGSDILL MANUFACTURING CO.

DETROIT *Originators of the Ground Radial Relief Centerdrill* **MICHIGAN**



VICTOR
COLLAPSIBLE TAPS

At Birmingham Iron Foundry
DERBY, CONN.

The work shown is cast iron steam plates for a hydraulic rubber-mill press, in each end of which five holes, 1″ long, are tapped with a Victor 1¼″ Collapsible Tap. It takes just 30 seconds "hole-to-hole" to complete one of these threads—i. e. to tap a good thread, collapse and withdraw the tap and move it to position ready to start on the next hole.

Two years of experience have convinced this company that Victor Collapsible Taps "cut good threads" and *never fail to collapse.*

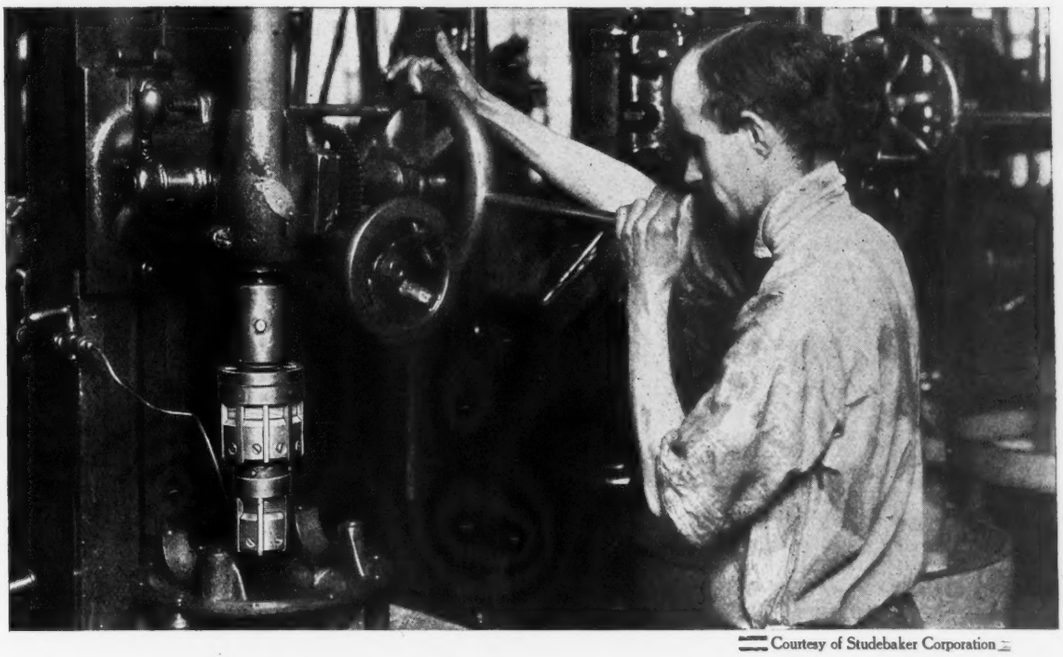
Let us tell you more about them

VICTOR TOOL CO., Inc.

WAYNESBORO Madison & W. M. R. R. **PA., U. S. A.**

REPRESENTATIVES: New England, O. H. Lorange, Boston, Illinois and Wisconsin. Eugene Goller & Co., Chicago. Indiana, Thomson Tool & Supply Co., Indianapolis. Philadelphia, Swind Machinery Company.

McCrosky
COST CUTTING TOOLS



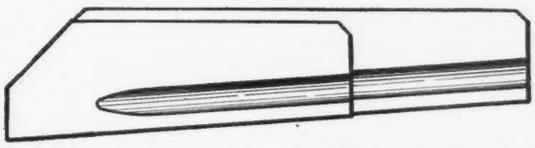
Courtesy of Studebaker Corporation

1250 to 1400 Holes per Grind Reamed by These Two

McCROSKY-SUPER ADJUSTABLE REAMERS

They ream the main bores in the rear axle pinion carrier of every Studebaker chassis manufactured in the Detroit plant of the Studebaker Corporation. Their diameters are 2.860 in. and 4.1875 in. The material is semi-steel. The amount of stock removed is from .012 in. to .015 in.

Long and Economical Service



1250 to 1400 holes between grinds is only one factor of McCrosky-Super service and economy. To compute the whole amount the average per grind must be multiplied by two other facts. (1) McCrosky-Super blades average 10 to 20 radial grindings. How this is provided for is shown in the accompanying line drawing. It compares the actual, original size of a No. 6 McCrosky-Super blade—the size used in both of the reamers shown above—with the same blade after it has been reground for the last possible adjustment. The stock available for radial regrinding plus that of the opposite blade gives a total adjustment of .125 in. (2) New sets of blades can be easily and quickly inserted in the original body, making the reamer as good as new.

These are the big reasons why so many manufacturing and automotive plants find McCrosky-Super Reamers unsurpassed for long and economical service.

The Detroit plant of the Studebaker Corporation has standardized on McCrosky-Super Reamers. Why don't you? McCrosky Catalog No. 8 will show you the style and size for your particular job. Let us send you a copy

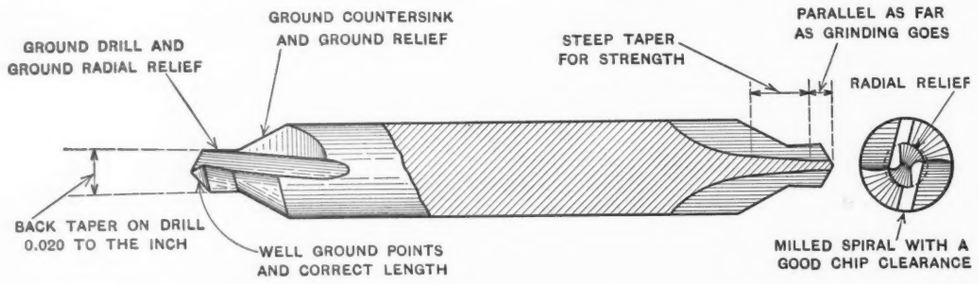
McCrosky Tool Corporation, Meadville, Pa., U. S. A.

Branches in Boston, New York, Detroit, Chicago, San Francisco

Agencies in all other principal cities

Export Agents: Benjamin Whittaker, Inc., 21 State Street, New York. Benjamin Whittaker, Ltd., 56 Ludgate Hill, London, E. C. 4

A Tool Designed to Center Holes and Save Money



The Slocomb Combination Center Drill

A handy tool in any shop—invaluable to many. Small, but chock full of virtue—designed not only to save the cost of an extra tool; but to give more uniformly accurate results than can be obtained by the old two-tool method. We designed special machines to keep down the manufacturing costs, perfected special methods of hardening and tempering; we sandblast the flutes after hardening before finish grinding the drill points and countersinks.

More details? Certainly, in Catalog 16

J. T. SLOCOMB CO., Providence, R. I., U. S. A.

CHICAGO REPRESENTATIVE: R. R. Street & Co., 28 N. Clinton Street.
PACIFIC COAST REPRESENTATIVES: The Charles A. Dowd Sales Co., 320 Market Street, San Francisco, California.
FOREIGN AGENTS: England: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, and Glasgow. Japan: Alfred Herbert, Ltd., Yokohama. Italy: Chas. Civita, Milan. Australia: Edwin Wood, Pty., Ltd., Melbourne and Sydney. France: Aux Forges de Vulcain, Paris, Lyons, Lille and Bordeaux.



"HUNTER"

PNEUMATIC HAMMER

RIVET SETS

—AND—

CHISEL BLANKS

The shanks of our Rivet Sets are faced to a slight radius. This insures the piston coming in contact in line with the axis of set, increasing the effect of piston stroke on rivets, a particular advantage when hammer cylinders are worn, with a marked reduction in shank breakage. Standard chisel blanks are made from ¾" x 9" or ⅞" x 8" octagon stock.

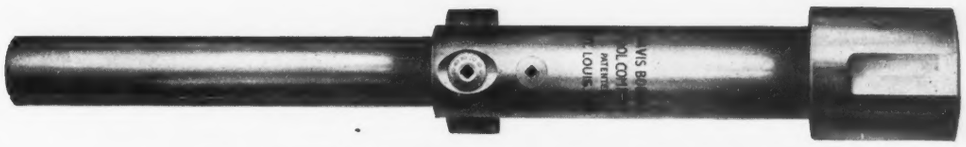
A full line carried in stock.

Hunter specialties include—Hot Saws, Friction Discs, Solid Blades made of Vanadium, Tungsten and Chrome Alloy Steel. Saw Sharpening Machines. Inserted Tooth Grinders. Hardened Steel Specialties.

Hunter Saw & Machine Company

Pittsburgh, Pa.

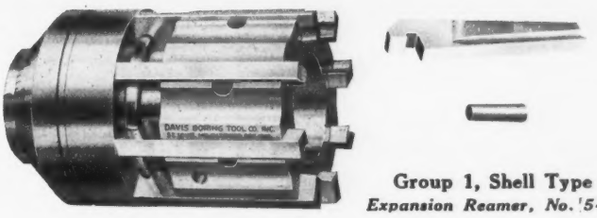
"A TOOL FOR EVERY MACHINE THAT BORES"



STYLE "E" TOOL—INDISPENSABLE FOR TURRET LATHES

Davis

EXPANSION BORING TOOLS AND REAMERS



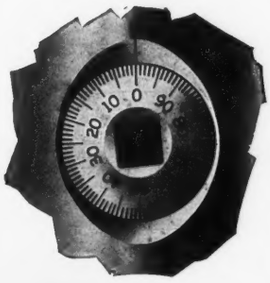
Group 1, Shell Type
Expansion Reamer, No. 540

Production Tools

Meeting the production demands of those plants, where maximum efficiency is maintained, with Davis Tools, clearly denotes the possibilities and advantages of Davis Expansion Boring Tools and Reamers in your own shop. There is no guesswork as to the results that these tools will produce—their merit is recognized in thousands of shops, where they have demonstrated their efficiency and adaptability.

Practical expansion, to compensate for wear, or to bore any size within range of tool, insures absolute accuracy, in boring or reaming, at a guaranteed saving of 25% in cost.

The illustration shows some special types of Davis Expansion Boring Tools, giving satisfaction in one of the largest plants in the country.



Micrometer Adjustment for Expanding Cutters to Size

Let us help you solve your production problems

With 19 years of constant effort, devoted to the exclusive manufacture of boring and reaming equipment, and with a competent staff of engineers, we are qualified in offering suggestions on boring or reaming equipment for any production requirements.

Send for literature and full particulars on Davis Boring Tools and Reamers.



DAVIS BORING TOOL CO.
INCORPORATED
3714-24 FOREST PARK BLVD.
ST. LOUIS, MO.

LARGEST EXCLUSIVE MANUFACTURERS OF EXPANSION BORING TOOLS AND EXPANSION REAMERS



Colton-Detroit Twist Drills

You Are Buying Holes—or Drills?

If you buy a motor car, you are really buying mileage. If you buy Colton-Detroit Twist Drills you are buying holes—the most holes per dollar of cost.

You have never had drills like Colton-Detroits. They are not milled—they are forged from special steel in accurate dies. Match them with what you are now using.

Colton-Detroit quality at fair prices is something you can't overlook. Point for point, there is no drill value on the market superior to Colton-Detroit. Ask for facts.

ARTHUR COLTON COMPANY, Detroit, Mich.

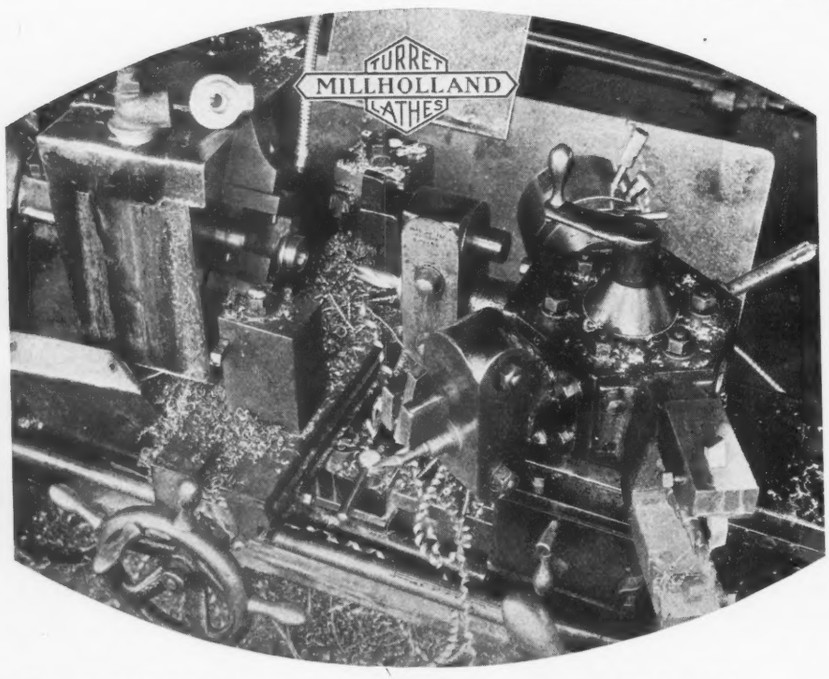
2618 Jefferson Avenue, East

REPRESENTATIVES: **Buffalo:** P. F. Fosnight, Ellicott Square Bldg. **Chicago:** H. E. Barton Tool Co., 106 S. Jefferson St. **Milwaukee:** General Sales Agency, 3205 Vine St. **New York City:** F. A. Brady, Inc., 30 Church St. **Pittsburgh:** W. E. Nagle & Son, Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Company, 745 North Sixty-third St. **San Francisco:** L. G. Henes, 75 Fremont St. **Los Angeles:** L. G. Henes, 218 East Third St. **Cincinnati:** Advance Tool Co., Canal and Jackson Streets.



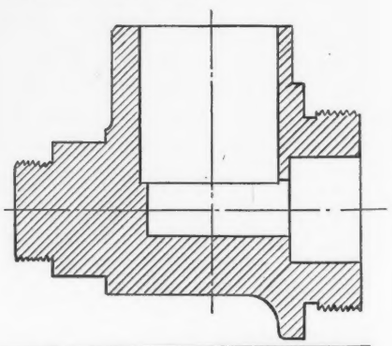
3 Chuckings—8 Minutes

Finished All Over on a MILLHOLLAND TURRET LATHE Tooled for Production by Millholland Engineers!



A drop forged steering wheel lock body machined from the solid on a No. 4 Millholland turret lathe, tooled for production by Millholland Engineers.

Let us tell you how we would handle similar pieces of your own work.



MILLHOLLAND MACHINE COMPANY

1102 West 23rd Street **INDIANAPOLIS, IND.**

ATKINS

METAL CUTTING SAWS

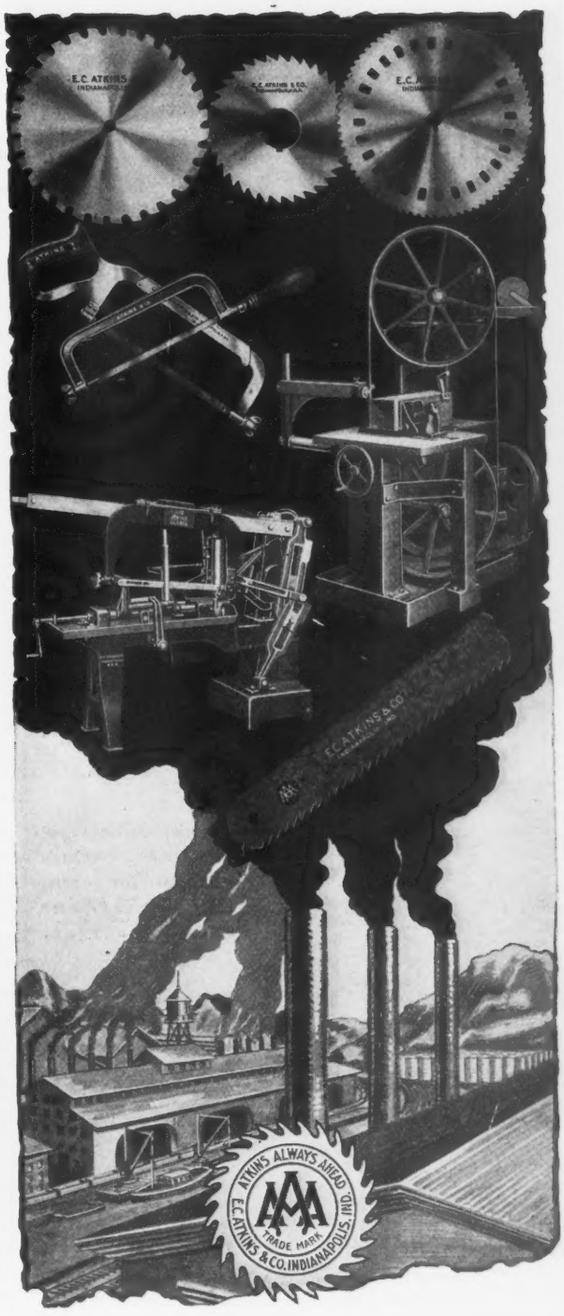
Are You Cutting Your Metal Economically?

If you are not equipped with an Atkins Metal Band Saw or a Kwik-Kut Metal Cutting Machine, you are overlooking an important factor in production, These machines are the most efficient for cutting iron, steel and other metals, fast, smooth and accurately. Write us for prices.

CIRCULAR METAL CUTTING SAWS. We make Circular Metal Cutting Saws of the best material and temper; they will cut your steel quickly without undue strain or effort. Send for complete treatise on Circular Metal Cutting Saws.

HACK SAW BLADES AND FRAMES. We manufacture the most complete line of Hack Saw Blades for hand frame use and solicit a trial order for Atkins Non-Breakable Blades. They will prove that they are the cheapest you can buy in the long run. We also manufacture All Hard Blades for hand frames and AAA Power Blades for Hack Saw Machines as well as Solid and Adjustable Hack Saw Frames for shop use.

SCREW SLOTTING AND MILLING SAWS. Send us your specifications and we will quote you our lowest current prices for quick delivery.



E.C. ATKINS & CO.

ESTABLISHED 1857 THE SILVER STEEL SAW PEOPLE

Home Office and Factory, INDIANAPOLIS, INDIANA

Canadian Factory, Hamilton Ontario

Machine Knife Factory, Lancaster N.Y.

Branches Carrying Complete Stocks In The Following Cities:

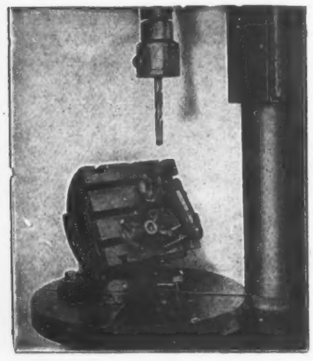
Atlanta	New Orleans	Seattle
Memphis	New York City	Paris, France
Chicago	Portland, Ore.	Sydney, N. S. W.
Minneapolis	San Francisco	Vancouver, B.C.



Think of Your Handicap Without This Angle Plate

Do you realize what the absence of the Universal Angle Plate from your shop means in lost time and money? The Universal is low in cost; it does the work of high-priced special fixtures. Try it out, and see what it does for you.

The Universal Angle Plate holds work in any position. Just clamp the work to the plate, adjust to the requisite angle, then go ahead—mill, drill, grind, plane, etc. Do any operation the job calls for without resetting the work. Motion is through 360° horizontally and 90° vertically.



Vernier attachment reading to 5 minutes provides for extra fine work. Four sizes; two styles.

Write for complete description.

Boston Scale & Machine Co.

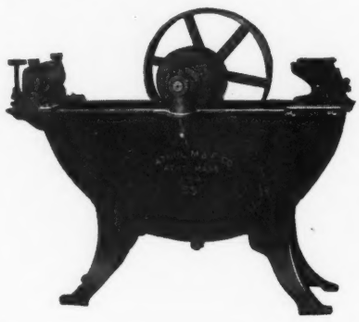
100 Ruggles Street ROXBURY, MASS.

Agents for Great Britain, Belgium, Italy, India, Burmah and Ceylon, Japan, Formosa and Korea, Alfred Herbert, Ltd., Coventry, England.

This Iron Grindstone Frame is an ATHOL Product

Takes a wheel 42″ diameter, with 6″ face; a 5″ pulley, 20″ diameter; and is equipped with automatic truing attachment and tool rest—both adjustable. Bearings are babbitt lined; weigh, packed for shipment, without wheel, 500 lbs.

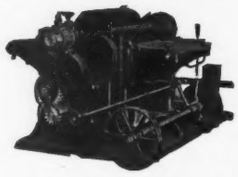
A New Catalog No. 35—just off the press—Describes ATHOL and ATHOL-STARRETT Lines.



Athol Machine & Foundry Co.

ATHOL, MASS., U. S. A.

Crescent Wood Working Machinery



is popular because the machines are durable and always please our customers. The time will come when you will need additional equipment to help you speed up production so you had better get a little ahead of your requirements and ask for catalog today describing band saws, jointers, saw tables, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisel mortisers, universal wood workers, table cut off saw.

THE CRESCENT MACHINE CO.

56 MAIN STREET LEETONIA, OHIO

Anderson Ways Give Quick Balance



They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

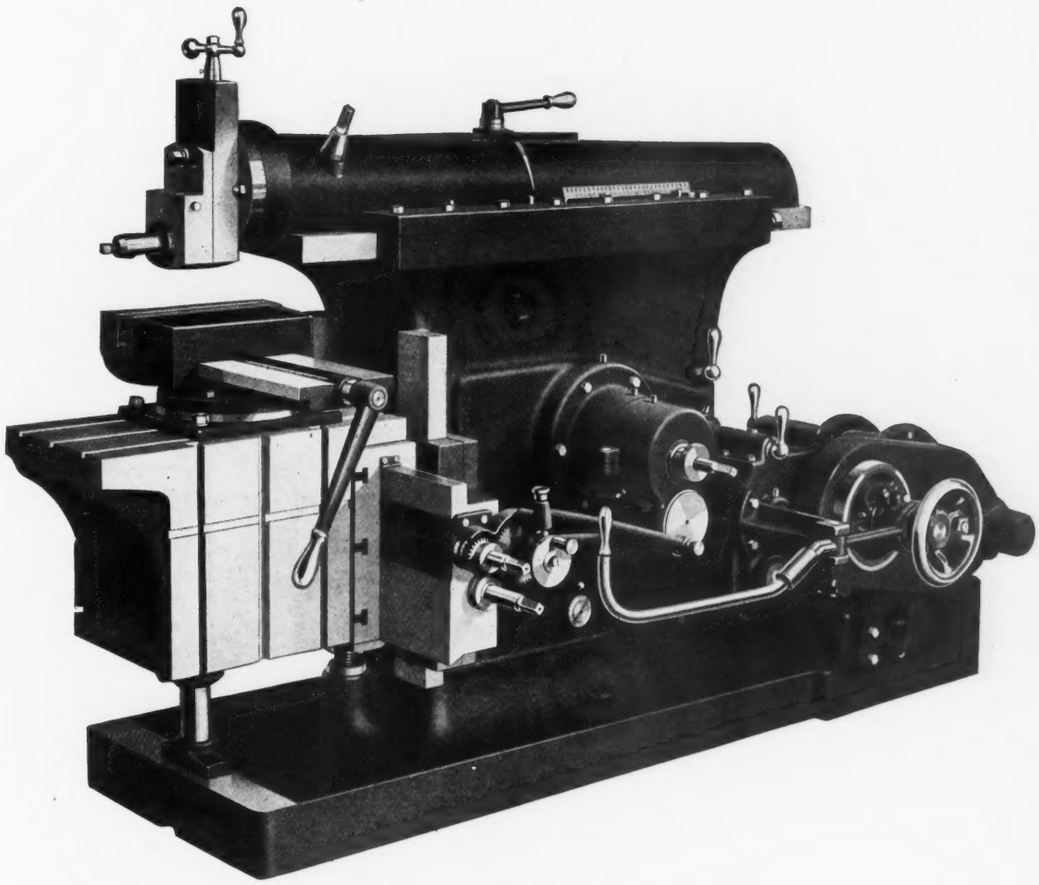
Anderson Improved Ways are extremely sensitive—designed and built with care—a truly high-grade product.

Manufactured by

ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD ILLINOIS

ROCKFORD SHAPERS

With Speed Boxes Are Proven Time Savers



THESE AID IN SAVING TIME

SPEED IN OPERATION
CONVENIENCE OF CONTROL
POWER TO MEET DEMANDS
ACCURACY IN PERFORMANCE
DURABILITY OF CONSTRUCTION

We will supply Gear Boxes on our 16", 20", 24" and 28" Motor Drive or Single Pulley Drive Shapers.

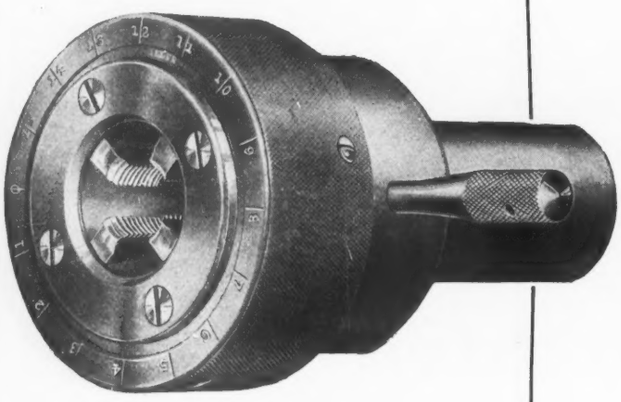
ROCKFORD MACHINE TOOL COMPANY

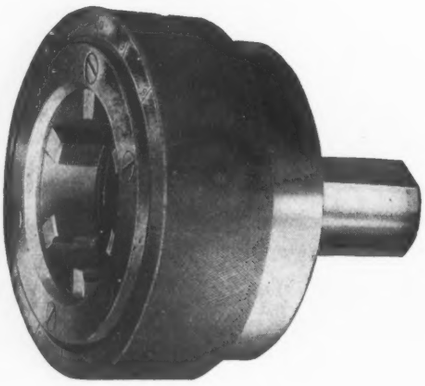
2400 Kishwaukee Street ROCKFORD, ILL., U. S. A.

Murchey Service

Correct Tooling for Profitable Threading







Murchey Collapsing Taps and Expanding Die Heads are production tools; dependable, simple, easily adjusted, long lived, *accurate*. They give profitable service on all classes of threading work.

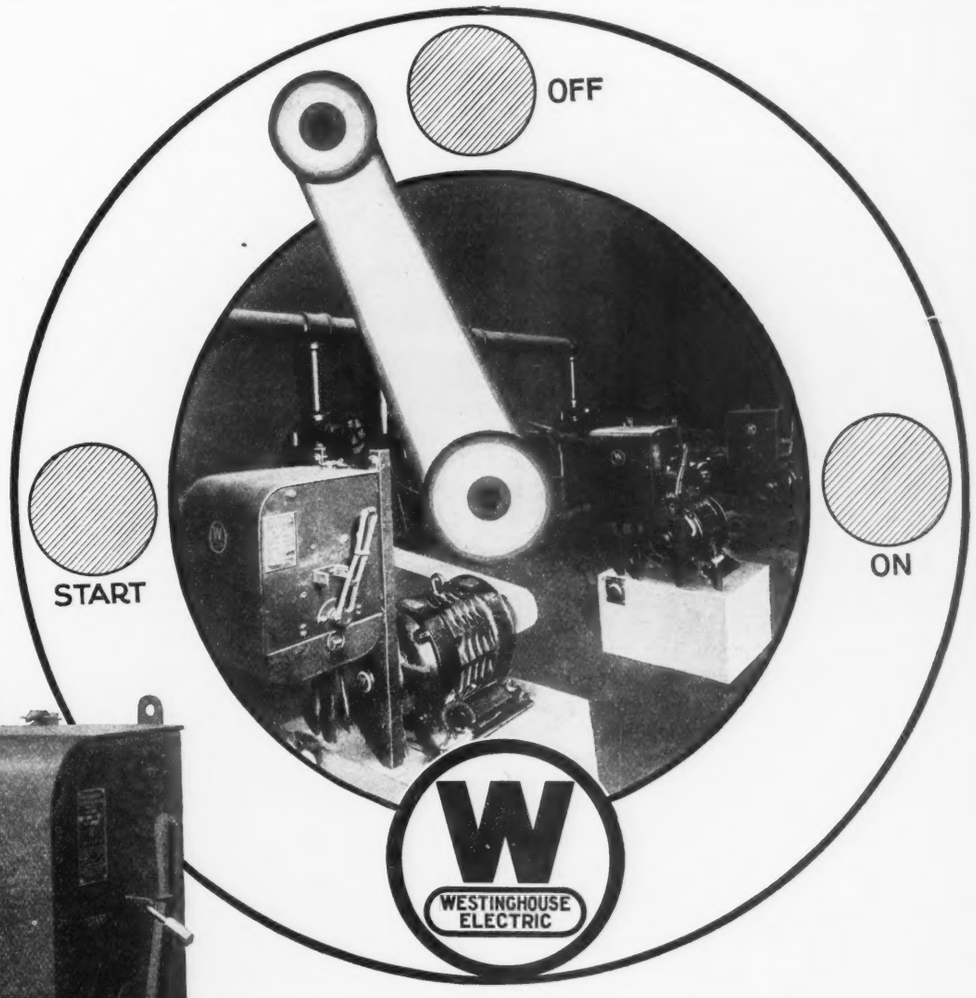
If you are "tooling up for production" send for the catalog of our standard tools. If your work includes special threading operations send us a blueprint or sketch and we will develop the tool to handle it.

Murchey Machine & Tool Company

34 Porter Street, Detroit, Michigan

CLEVELAND OFFICE
6523 Euclid Ave.

NEW YORK OFFICE
99 Warren Street





Safe—and Easy to Operate

The operator of a Westinghouse Auto Starter has a single handle to use. This handle operates the entire switch, which includes starting and stopping mechanism. The auto starter provides also overload protection devices for the motor which are adjustable in order to meet the requirements of the driven machine.

The Westinghouse Type A Auto Starter is equipped with the new Westinghouse rolling contacts which, together with its general excellent mechanical and electrical construction, give satisfactory service even where the application requires many operations a day. It will give complete control and protection to squirrel cage motors.

It is totally enclosed in dustproof sheet steel case with felt packed grooves.

Features of the Type A Auto Starter

Dust Proof Construction
Totally Enclosed
Easy to Operate
Interlocked Handle
Safety Interlock
Automatic in Operation
One Handle for Starting and Stopping
Safe for Operators

Westinghouse Electric & Manufacturing Company
EAST PITTSBURGH, PA.
Sales Offices in All Principal American Cities

Westinghouse
INDUSTRIAL CONTROLLERS

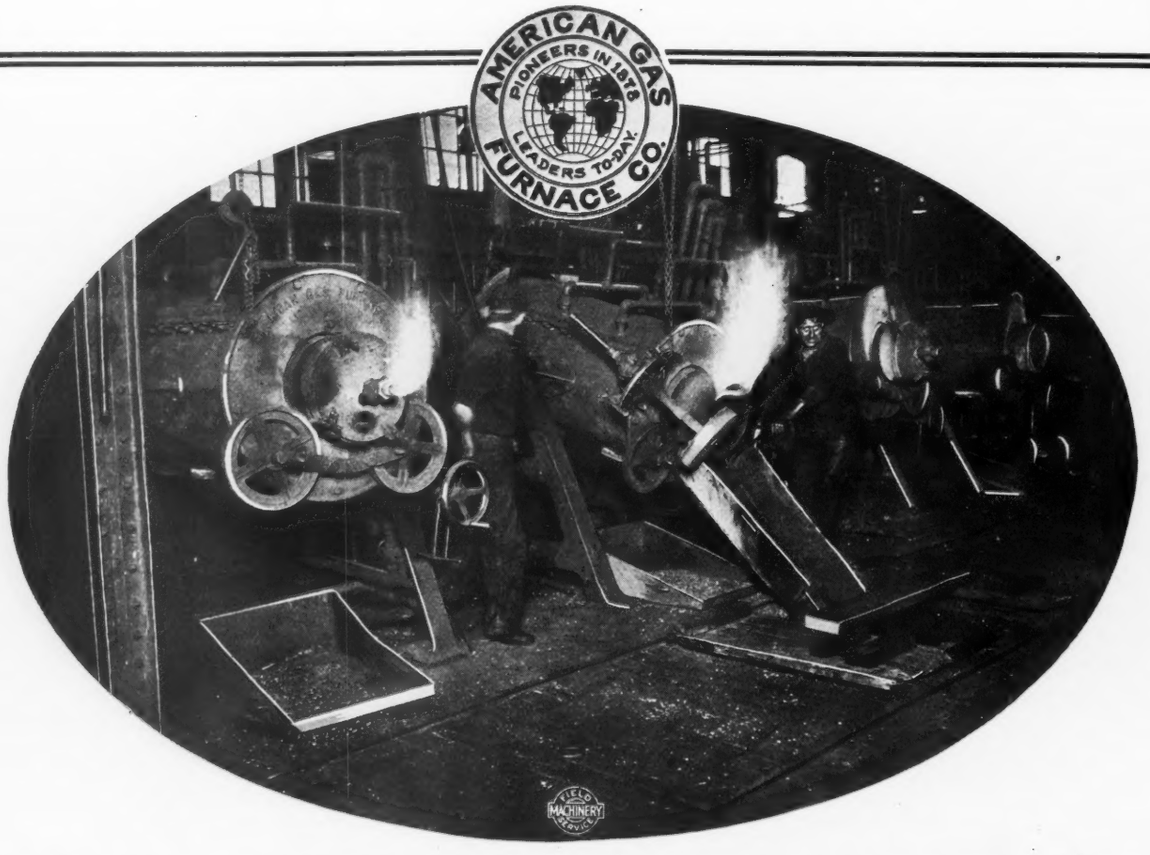
Parts for Baldwin Chains Are Carbonized in

American Rotary Gas Furnaces

Before the Baldwin Chain & Manufacturing Company, of Worcester, Mass., installed this battery of American Gas "Rotaries," pins, rollers and other parts for its famous chains were packed for several hours in containers, placed in a furnace, and afterwards quenched. For the last four years, however, they have been merely loaded into the revolving retort of American Gas Furnaces—about 350 lbs. per load—and rotated for 2½ hours; then tipped into a quenching tank, as shown. Gas burning between the retort and the interior of the furnace brings the work rapidly to the correct temperature and automatic heat control maintains it at uniform temperature throughout the entire operation; while from carbon gas, passing through the retort, carbon is absorbed by the tumbling pieces to a more uniform depth on all surfaces than could be obtained by the old method.

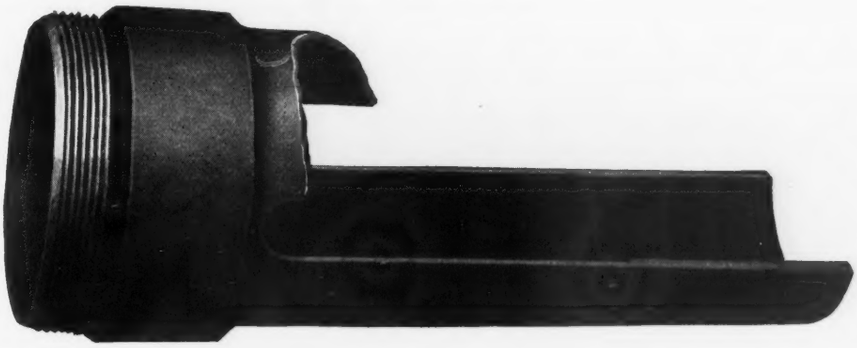
There are eight of these machines in the "Baldwin" installation—clean, compact, easy to operate and entirely dependable. American Gas Furnaces cover all heat treating requirements—from tool room to rolling mills—and our service department will be glad to discuss their respective advantages in connection with your work.

Our line includes: Gas Furnaces, Carbonizing Furnaces and Machines, Pressure Blowers, Heating Machines, Automatic Heat Controllers, Forges, Cylindrical and Oven Furnaces and every type of Gas Blast Furnace and Heating Machine for Industrial Uses.



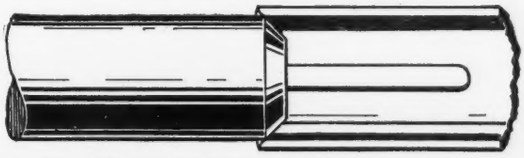
AMERICAN GAS FURNACE COMPANY

Main Office and Works: ELIZABETH, NEW JERSEY

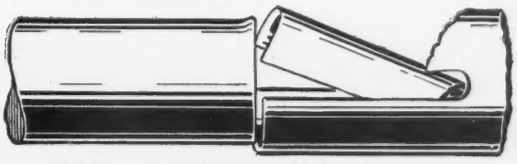


This feed finger was broken by a burred rod

This accident stopped production for 25 minutes and caused a loss of $12.50 for replacing feed finger. It would not have happened with Bridgeport Ledrite Brass Rod because all Ledrite rod is chamfered on the ends.



The Ledrite chamfered end eliminates danger of broken feed fingers.



This shows how a burred rod broke a feed finger.

Ledrite Rod as made by Bridgeport Electric Furnace processes, in addition to being chamfered at both ends, is the best free-cutting composition, a composition which is accurately maintained by testing. No screw machine spindle speed is too high for Ledrite Rod. Ask for our Brass Rod Book No. 1439.

BRIDGEPORT BRASS COMPANY, Bridgeport, Conn.

"Bridgeport" BRASS CO. TRADE MARK U.S.A. U.S.A.

Bridgeport Ledrite Brass Rod It's Tested

2319

Rickert-Shafer Automatic, Positive Opening, Adjustable Die Heads



Made in 21 sizes — 1/16" to 9" Capacity

Standard in many shops.

Bulletin V Explains.

Accurate Threads in Any Quantity— Right Up to the Shoulder—and Fast

Wheel hubs for automobiles, water tight pump bodies for motors and studs for auto cylinder heads are among the many threaded parts, all subject to thread gage inspection, which are regularly cut with R-S Die Heads. They are used also for steering gear pinions, carrier screws and other parts in which the thread must run up to the shoulder. Even brass castings can be threaded to advantage the R-S way—gage valve stems for 2" at 60 per hour; and hose bibs, 25,020 between grinds.

RICKERT-SHAFER CO.

612 W. 12th St., Erie, Pa., NEW YORK OFFICE; 50 Church Street

BRANCH OFFICES: 380 Rockefeller Bldg., Cleveland, Ohio; 117 North Jefferson St., Chicago, Ill.; 50 Church St., New York, N. Y.; 222 West Larned St., Detroit, Mich.; 414 Elm St., Cincinnati, Ohio; 807 Iroquois Bldg., Buffalo, N. Y. AGENTS: Stocker-Rumely-Wachs Co., Chicago, Ill.; Strong, Carlisle & Hammond, Cleveland, Ohio; Michigan Metal Supply Co., Detroit, Mich.; Peter Frasse & Co., New York City, N. Y.

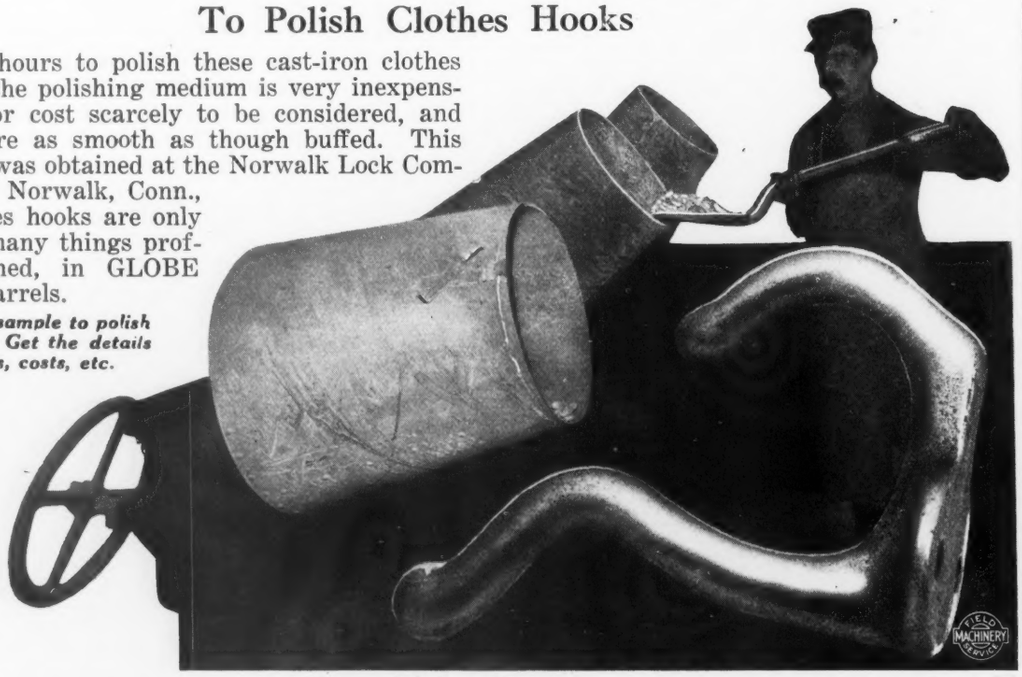
PEBBLES AND SAND IN

GLOBE TUMBLING BARRELS

To Polish Clothes Hooks

It takes 12 hours to polish these cast-iron clothes hooks—but the polishing medium is very inexpensive, the labor cost scarcely to be considered, and the hooks are as smooth as though buffed. This photograph was obtained at the Norwalk Lock Company, South Norwalk, Conn., where clothes hooks are only one of the many things profitably polished, in GLOBE Tumbling Barrels.

Send us a sample to polish for you. Get the details of methods, costs, etc.



THE GLOBE MACHINE & STAMPING CO., 1250 West 76th St., Cleveland, O.

Also Manufacturers of Sheet Metal Stampings, Dies and Tools

Foreign Representatives: J. Horstmann, 81-83 Rue Saint Maur, Paris, France; 46 Rue Juliette-Recamier, Lyons, France.

U-LOY STEELS

From the Electric Furnace

A heavy switch is thrown—electricity of enormous power is released. An arc forms between the electrodes and the charge. Soon melting takes place.

So intense is this arc that it refines steel to a higher degree of purity than any other method. The injurious effects of sulphur and phosphorus are reduced to a minimum. Impurities are removed. Greatest freedom from surface and subsurface defects is insured. In purity, uniformity and homogeneity U-LOY Electric Furnace Steels are far superior to even the best open hearth steel.

Perhaps U-LOY Electric Furnace Steels would improve your product—*no matter what it may be.*

UNITED ALLOY STEEL CORPORATION
CANTON, OHIO

New York	Chicago	San Francisco
Syracuse	Detroit	Indianapolis
Cleveland	Buffalo	Portland

Open Hearth and Electric Furnace U-LOY Steels are furnished in:—

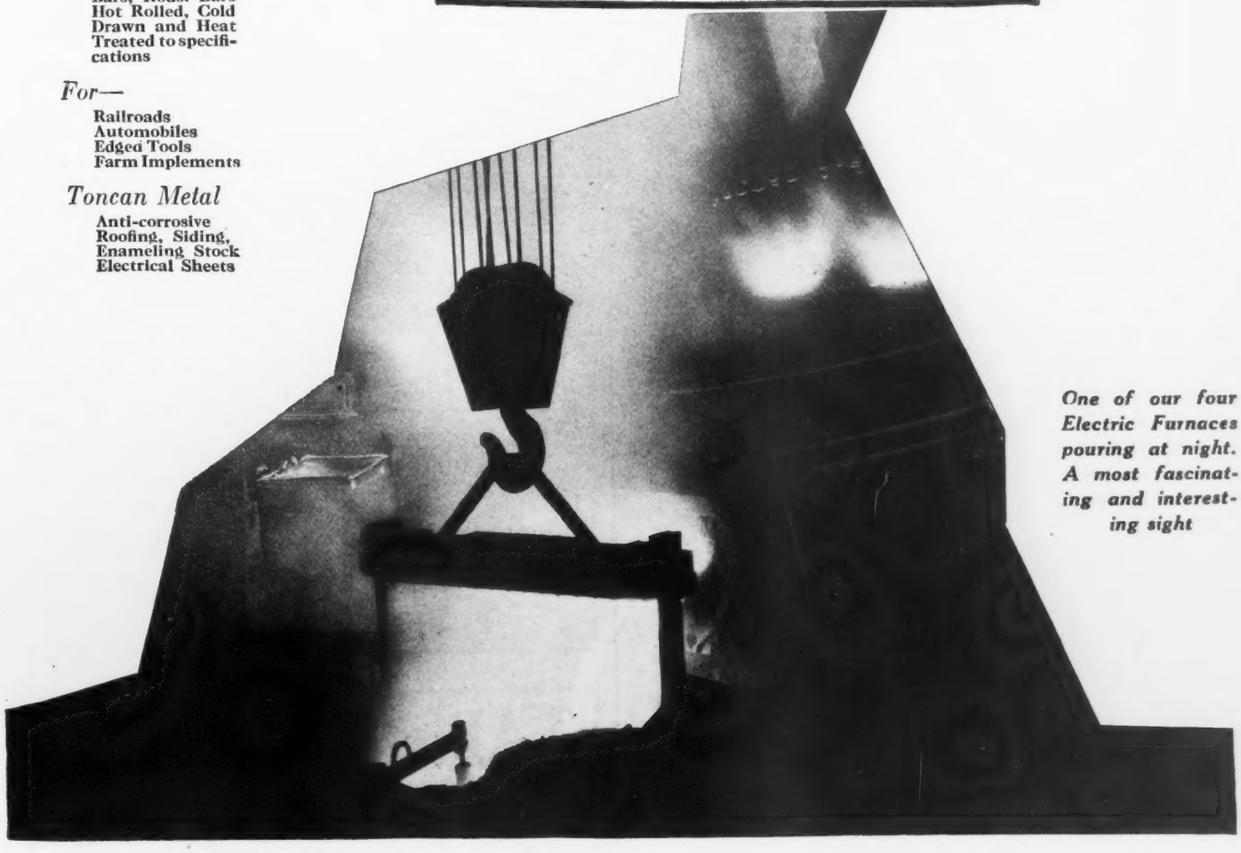
Blooms, Slabs, Billets, Plates, Bars, Rods. Bars Hot Rolled, Cold Drawn and Heat Treated to specifications

For—

Railroads
Automobiles
Edged Tools
Farm Implements

Toncan Metal

Anti-corrosive Roofing, Siding, Enameling Stock Electrical Sheets



One of our four Electric Furnaces pouring at night. A most fascinating and interesting sight

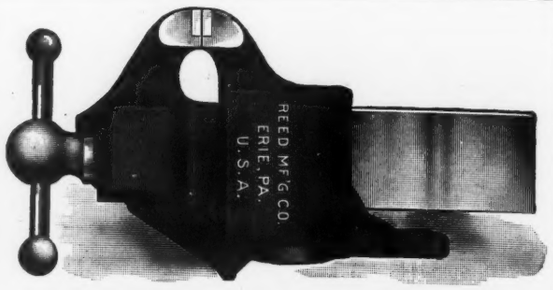


PARKER VISES

"Grip Like a Grizzly"

—because they have reserve strength ALL OVER! Renewable tool steel jaws, a steel "backbone" in the slide, a solid underportion, and a swivel that grips like the jaws! *Uniform sturdiness* has kept "Parkers" in the great U. S. and Canadian shops for over 80 years. Send for Feature Folder No. 5.

THE CHARLES PARKER COMPANY
Master Vise Makers, MERIDEN, CONN., U. S. A.



A Workman Can Produce More While Using a

REED VISE

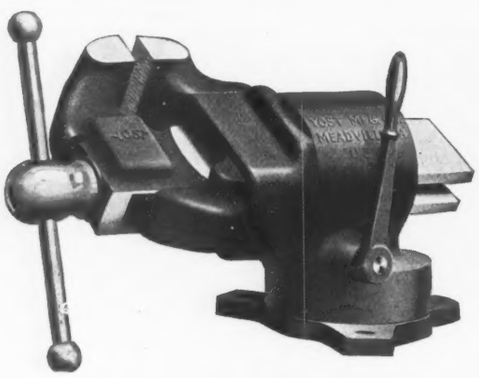
That's because the Reed is R-I-G-I-D, and does not give or spring under working stress.

A Reed is also easy working and so simple it does not require special attention to operate.

Of all the qualities a vise should possess RIGIDITY is probably most important. That's why we pay so much attention to *Rigidity.*

Send for Proof of Superiority

REED MANUFACTURING CO.
ERIE, PA.

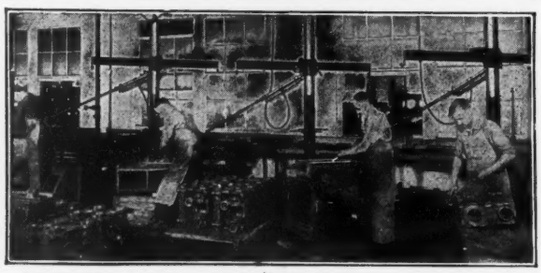


"YOST"

Yost service means most service. Yost Solid Vises with Stationary or Swivel Base match every need. If you have never used one, you have a treat in store. They survive every test, stand the stress of severe service and give unusual satisfaction.

Yost Vises are all fine tools of distinctive quality and long life. There are thousands of users ever eager to proclaim Yost satisfaction to others—talk to these men in your town—or write for particulars.

Yost Manufacturing Company
MEADVILLE, PA.



ANDERSON PNEUMATIC SCRAPERS

Skilled scrapers lose their skill toward quitting time—it's fatigue that cuts production. Anderson scrapers substitute air power for human muscle, yet maintain the quality of hand work. Write for catalog.

ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD ILLINOIS

DRILL VISE



Three Sizes

With and Without Jig Attachments
Often used on miller, shaper or planer.

Send for circulars

Other Tools
Drill Speeders
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The Graham Mfg. Co.
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Great Britain — Burton, Griffiths & Co.
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TAPS AND REAMERS

First-class Tools and Prompt Deliveries

REIFF & NESTOR CO., Lykens, Pa.

COLUMBIAN

Sledge-Tested VISES



With Many Superior Features

COLUMBIAN Sledge-Tested Vises are made of malleable iron —twice as strong as cast iron.

In depth of jaw and width of jaw opening they are oversize. The removable jaw steels are separately tempered and hardened. The diamond teeth are formed by cutting in two directions on a shaper. They do not wear smooth for many years. The machining of the tongue and groove is kept within limit of 1/1500 of an inch so that jaw faces are interchangeable.

Handles of cold rolled steel have forged ball ends that cannot come off. The front jaw is brought down to form a shield over the screw head, which keeps chips and filings out of the screw.

Columbian Sledge-Tested Vises work easiest, last longest—and cost no more.

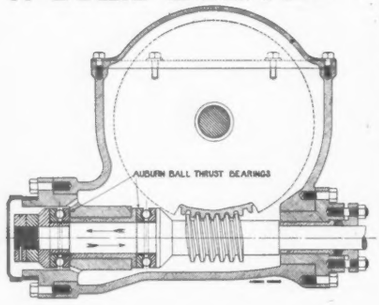
Specify Columbian and get more for your money.

The Columbian Hardware Co.

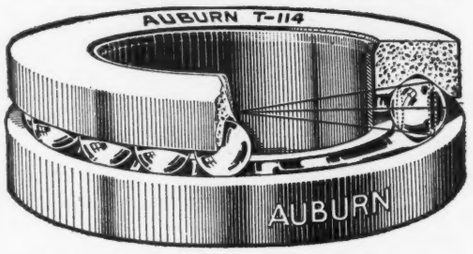
World's largest makers of vises and anvils.

CLEVELAND

WORM DRIVES have less backlash with AUBURN THRUSTS

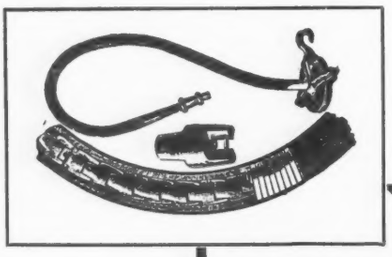


The Worm Drive has a minimum backlash when equipped with **AUBURN OPEN STYLE T-114 SELF CONTAINED BALL THRUST BEARING.** With its minimum of friction and wear, and with its uniformly maintained thickness, the **AUBURN THRUST BEARING** assures absence of backlash from worm thrust collars. Adopt **AUBURN THRUSTS** for your Worm Drives and end thrust troubles. Ask for Data Sheets and mail blueprints with information of your problem, today.



STEEL, BRASS AND BRONZE BALLS

AUBURN BALL BEARING CO., Trade Mark Established 1893 **33 Elizabeth St., Rochester, N.Y.**



THE IDEAL FLEXIBLE SHAFT For Every Purpose

Can be made to meet requirements not possible in other shafts such as running in both directions, delivering the maximum power, and in any length of section up to eight feet.

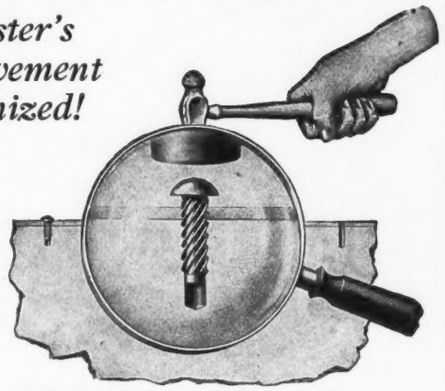
All parts interchangeable, sections can be coupled together thereby making a shaft of the greatest possible length.

Write us about your flexible shafting requirements

GEM MANUFACTURING COMPANY
PITTSBURGH, PENNA.

GEM FLEXIBLE SHAFTING

A Master's Achievement Recognized!



The

Parker Hardened Drive Screw

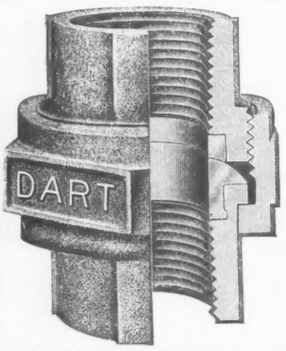
Can Rightfully Claim Your Notice

Hundreds upon hundreds of manufacturers have already adopted the Parker Hardened Drive Screw for attaching name plates and making fastenings to steel, cast iron and composition. It will surely be worth your time to get acquainted with this cost-cutting, labor-saving article.

The Hardened Drive Screws cut their own thread, under the blow of a hammer. No technical knowledge is needed to assure perfect fastening every time.

There is a size made that will just suit your particular needs. Just write that you want samples for test and they will be sent forthwith.

PARKER SUPPLY CO., Inc.
Dept. M NEW YORK
Branches
Chicago Philadelphia Springfield Minneapolis



DART

Unions, Ells, Tees and Flanges

Bronze to bronze seats make them rustproof; accurately cut threads guarantee against leakage—the kind of union that outlasts the pipe.

Try one—send for a sample today.

E. M. DART MFG. CO., Providence, R.I.
The Fairbanks Co., Sales Agents.
Canadian Factory: Dart Union Co., Ltd., Toronto

A Demonstration Will Convince You



MADISON Adjustable Boring Cutters and Bars.

The better way is the Madison Way—better and cheaper, too. Adjustment to .00025". For example, to finish a hole 3.753" set a 3¾" cutter out .003". Lower production costs—a Madison demonstration will quickly convince you. Write us.

MADISON MANUFACTURING COMPANY
MUSKEGON MICHIGAN

FORD TRIBLOC



From Every Angle

THAT patented Loop Guide keeps the hand chain of a Ford Tribloc from gagging or overriding its wheel—no matter from what angle or at what speed the Tribloc is operated.

And from whatever angle you consider the Tribloc—*speed, safety, convenience, efficiency*—it is the most satisfactory hand hoist made.

Capacities to 40 Tons

2210-D

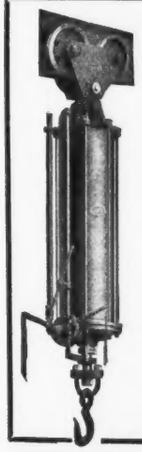
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2ND & DIAMOND STREETS PHILADELPHIA, PA.

OVER-SEAS REPRESENTATIVE

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

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Q M S PNEUMATIC HOISTS

Built to meet any condition of material handling. Accepted as standard equipment everywhere.

Hanna Engineering Works

1763 Elston Ave., CHICAGO, U. S. A.

Manufacturer and Distributor for

Mumford Molding Machine Co. Q M S Products

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"PIONEER" Steel Hangers

"HALLOWELL" Steel Bench Legs

Safe—Durable—Economical

Bulletins on request.

Standard Pressed Steel Co.

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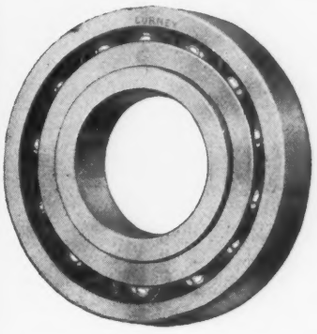
STEEL STAMPS

Send your Inquiries and Orders to the Manufacturer

JAS. H. MATTHEWS & CO.

2266 Forbes Field Pittsburgh, Pa.

MATTHEWS



Speed

YOU don't have to use ball bearings to keep things turning. This old world has been jogging along for quite a number of years, and until recently without ball bearings. There are other kinds that work passably well. We have seen old water wheels running fine with cast iron gudgeons running in sandstone boxes.

But things are speeding up a bit now. Spindles and shafts have to run now at speeds that a few years ago were utterly impossible. Twenty-five, forty, and even fifty thousand revolutions per minute are not only possible but are practical every day facts. The thing that made this possible is the modern ball bearing. And the particular ball bearings that are doing it are GURNEY'S

Gurney Ball Bearing Co.

Conrad Patent Licensee

Jamestown, N. Y.

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GURNEY BALL BEARINGS



Colburn Relies on Bunting



The good name of Colburn relies on Bunting Bushings to uphold the Colburn standard of quality and performance.

The Colburn Machine Tool Company is one of many that have found Bunting Bushings eminently worthy of confidence.

We have 150 different sizes of completely finished Bunting Bushings always in stock. They fit almost any requirement. They cost less and are always ready.

Write for Stock List "G"

The Bunting Brass & Bronze Company

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Grand Central Palace
Vanderbilt 7300

Chicago
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Wabash 9153

Cleveland
1362 East 6th St.
Main 5991

San Francisco
198 Second St., cor. Howard
Douglas 6245

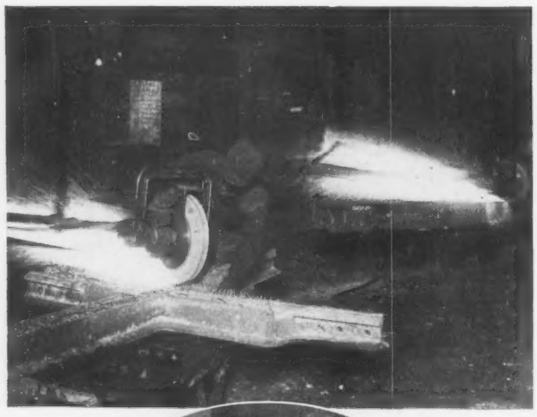
Boston
36 Oliver St.
Main 8488

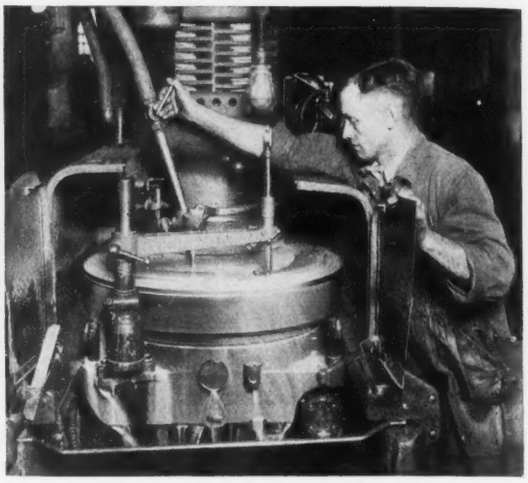


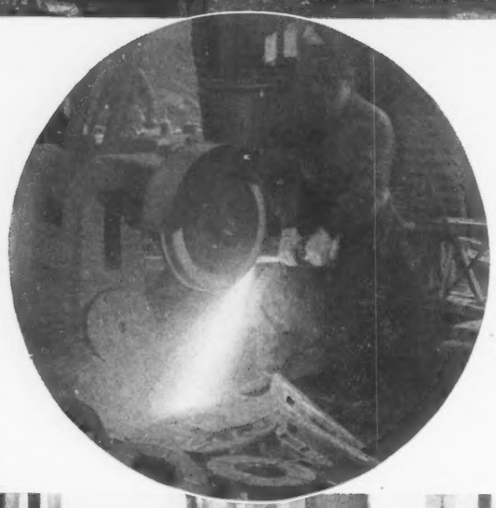
Grinding in the Industries

The second of the series of five grinding articles to be published under the general title "Grinding in the Industries" appears in the editorial pages of this number of MACHINERY. This series will show by actual examples the remarkable development of grinding practice in our big industries, including the automotive, small tool, railway, foundry and steel mill.

The advancement in the modern art of grinding has been so fast that intensive study must be given every new machine, improvement or method. The advertising which follows this page is the grinding machine, grinding wheel and grinding accessory manufacturers' contribution to further general knowledge of the most up-to-date methods in this rapidly developing field. In these specially prepared advertisements you will find data, pictures and examples of grinding work that will probably cause you to get out a pad and pencil and work up some figures of your own, and when an advertisement does this it has accomplished its mission.







The Right Abrasive, a Sufficient Wheel Stock, Experienced Men Mean

Grinding Wheel Service

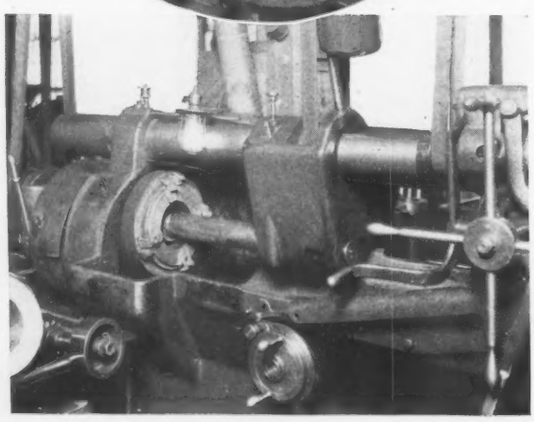
There are two main reasons for the success of Norton grinding wheels on every kind of grinding and under the many varieties of conditions:

1. Different kinds of abrasives, different bonding processes, and a great variety of grains and grades from which to select the wheel that will perform properly.

2. Knowing how to select the abrasive, the process and the grain and grade.

Briefly there is a Norton wheel made of the right abrasive for every condition of grinding; there are in the Norton Administration Building great quantities of data accumulated from experiences of demonstrators under many conditions, and there are Norton men who have a knowledge of grinding that enables them to select wheels of correct abrasive, bond and grain and grade.

You may be operating with a tremendous waste if you are using the wrong wheels on the job.



NORTON COMPANY

Worcester, Mass.

NEW YORK
53 Park Place

CHICAGO
11 North Jefferson St.

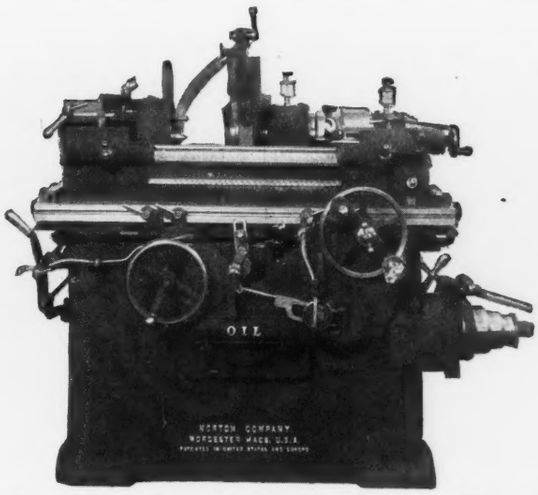
DETROIT
233 West Congress St.

Norton Company of Canada, Limited, Hamilton, Ontario.

R-156







Types for Crankpin, Crankshaft, Camshaft, Car Wheel and Roll Grinding

Norton Grinding Machines

There is a range of cylindrical grinding machine sizes from 6 x 32″ to 26 x 408″.

There are also Open-Side Surface Grinding Machines, a Universal Multipurpose Grinding Machine, Autopart Regrinding Machine for the regrinding of automobile cylindrical parts, Universal Tool and Cutter Grinding Machines and Grinding Wheel Bench and Floor Stands.

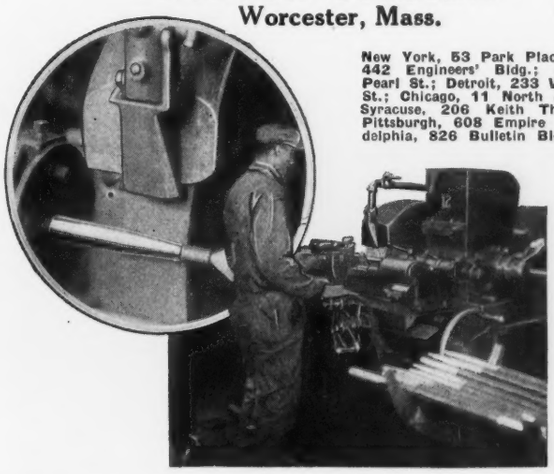
The A-Type Cylindrical Grinding Machine has stood up for many years in all kinds of manufacturing plants and in all parts of the world. It has never failed to make a good showing against competition.

The B-Type is a late development of cylindrical grinding machine with greater wheel power, greater traverse work speed, entirely self-contained and many improved features which give it a remarkable capacity for production.

The Multipurpose Grinding Machine is a new creation introducing many unique features. It is absolutely self-contained and it is a truly universal tool room machine for multipurpose grinding. We solicit an opportunity to figure with the production engineer.

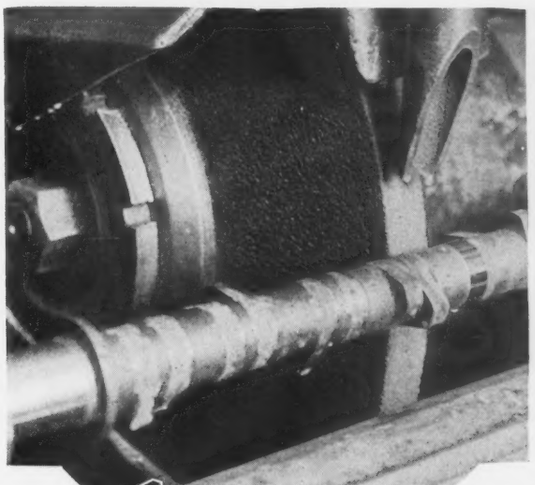
NORTON COMPANY

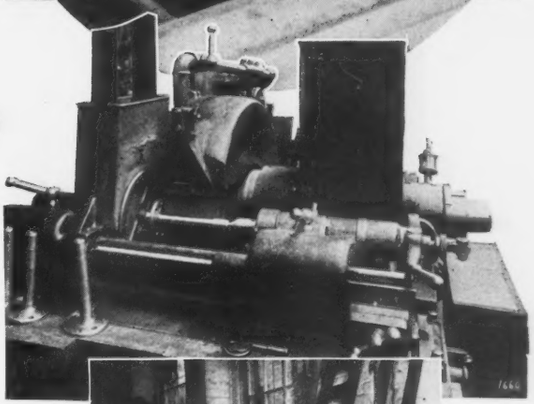
Worcester, Mass.



New York, 53 Park Place; Cleveland, 442 Engineers' Bldg.; Hartford, 49 Pearl St.; Detroit, 233 West Congress St.; Chicago, 11 North Jefferson St.; Syracuse, 206 Keith Theatre Bldg.; Pittsburgh, 608 Empire Bldg.; Philadelphia, 826 Bulletin Bldg.

M-47











266 IN A SINGLE PLANT

Large Batteries of Van Norman Automatic Radius Grinders are installed in the Leading Ball Bearing and Automobile Plants of this and other countries.

The Van Norman Automatic Oscillating Grinders—in the Commercial Production of High Grade Ball Bearings — have earned a world wide reputation. They have become a large factor in the Automotive and Ball Bearing industries—for Radius Grinding of various parts.

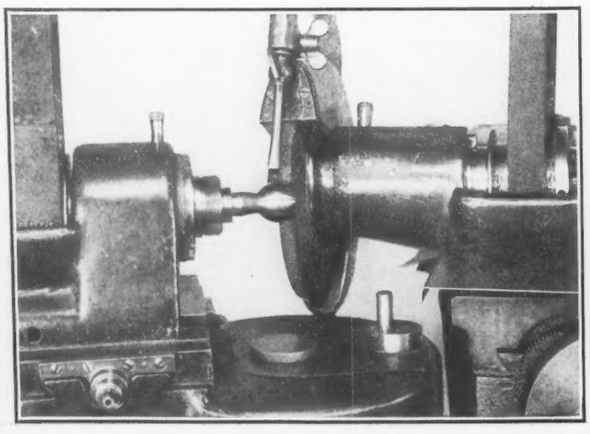
Quality production at a minimum cost—with extreme accuracy and refinement of finish.

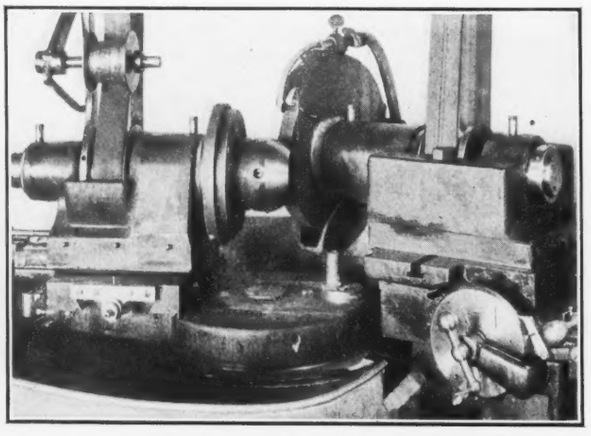
Compact, rigid, handy to manipulate—two or more machines can be handled by one operator.

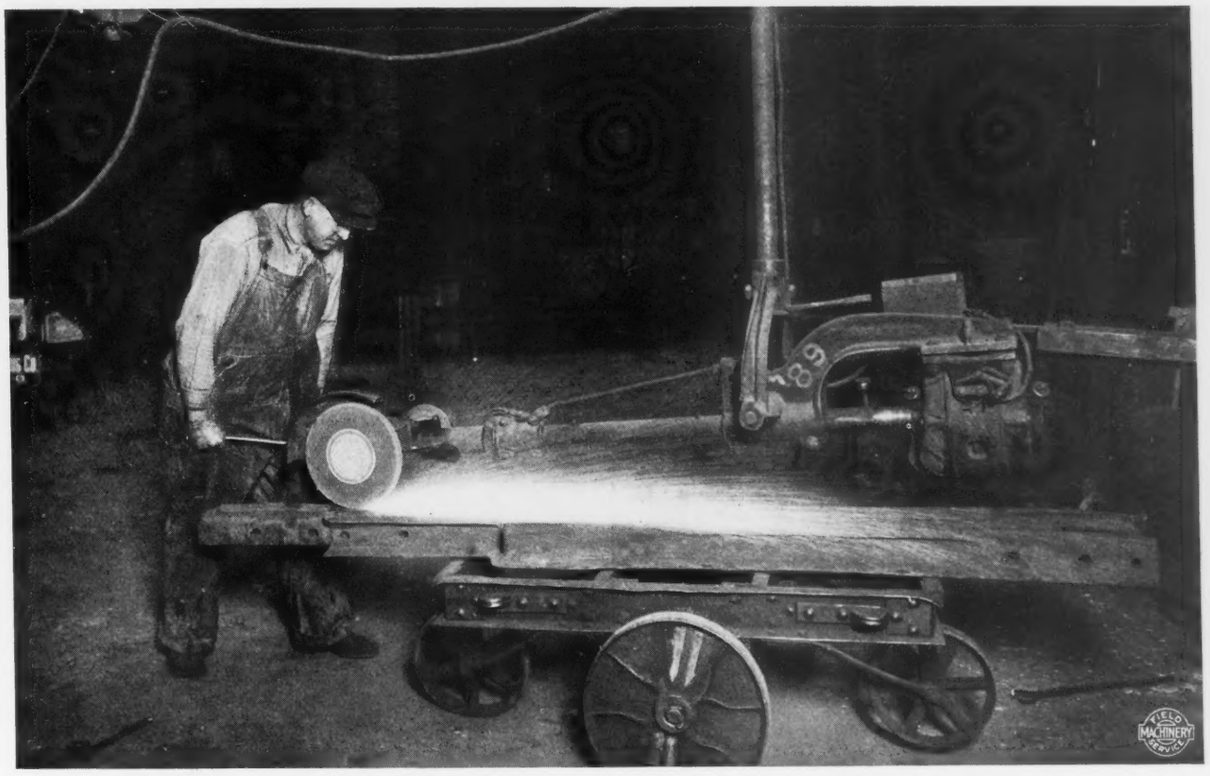
If you have a Radius Grinding problem, internal or external, consult us today—we are specialists.

Van Norman Machine Tool Company

180 Wilbraham Avenue, Springfield, Mass., U. S. A.







Where a Good Grinding Wheel is Needed

Ordinary steel tools won't cut manganese—it's too tough. Other methods must be found—and that's where it pays to turn to a known quality, the "Abrasive" Borolon Grinding Wheel.

A well known frog and switch manufacturer in the middle west is a large user of manganese. The photograph tells the rest of the story—the grinding of the top surface of manganese steel railroad switch. The wheel shown is a Borolon wheel 18″ diameter, 3″ face, grain 14, grade R. It gives satisfactory results because it is fast and cool cutting plus long lasting.

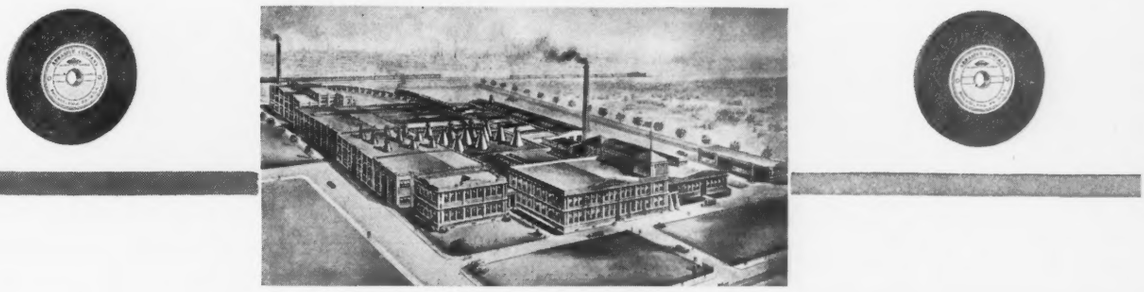
Let us tell you more about Borolon and Electrolon grinding wheels or polishing grain. Write us about your particular grinding or polishing problems.

Borolon
TRADE MARK
AND
Electrolon
TRADE MARK

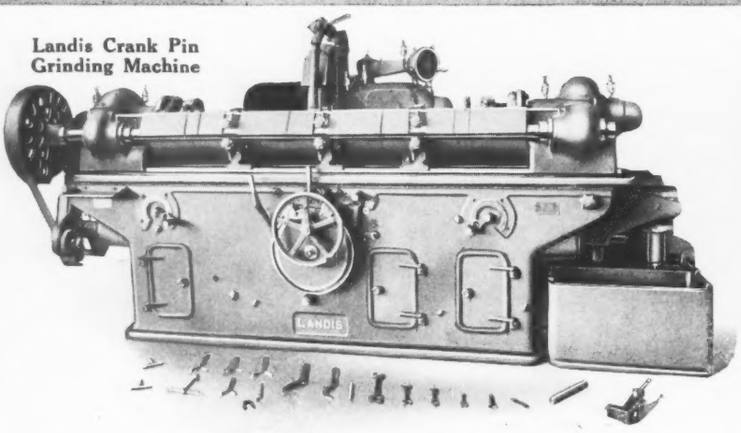
GRINDING WHEELS

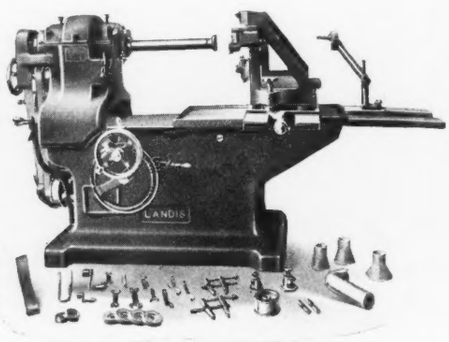
ABRASIVE COMPANY

BRIDESBURG, PHILADELPHIA, PA., U. S. A.
Chicago Branch: 566 W. Washington Boulevard

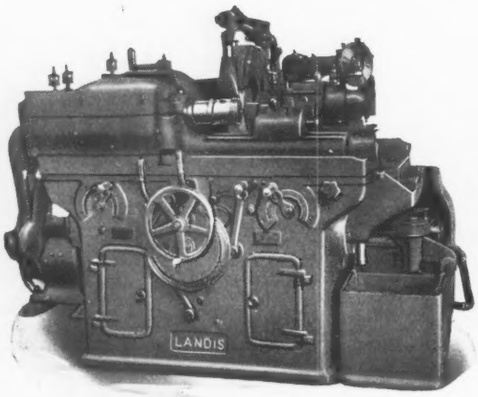


Landis Crank Pin Grinding Machine





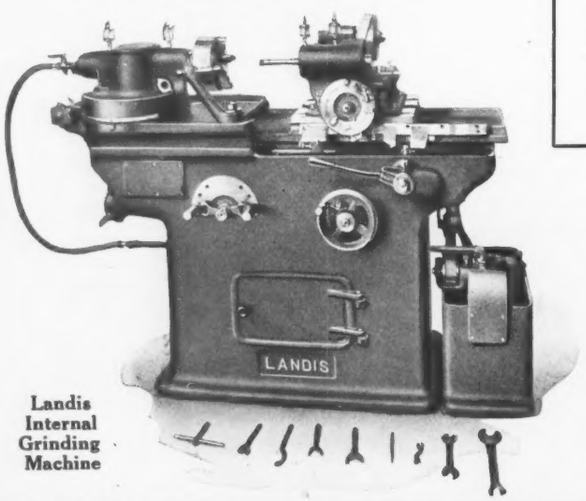
Landis No. 5 Cylinder Grinding Machine



Landis Piston Grinding Machine



Landis Ball Race Grinding Machine



Landis Internal Grinding Machine

Landis

Ten efficient grinding machines, each made for a different purpose and each fulfilling that purpose to the utmost satisfaction.

This group of representative machines is only a small part of the Landis line.

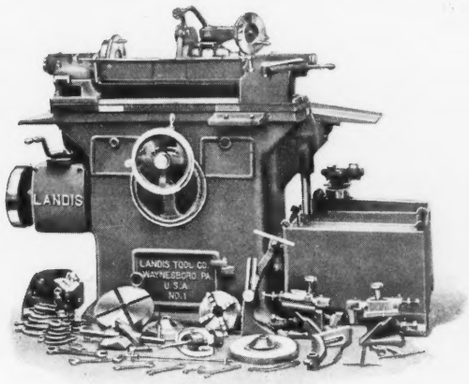
Grinders of every kind to handle every conceivable

LANDIS TO WAYNESBORO,

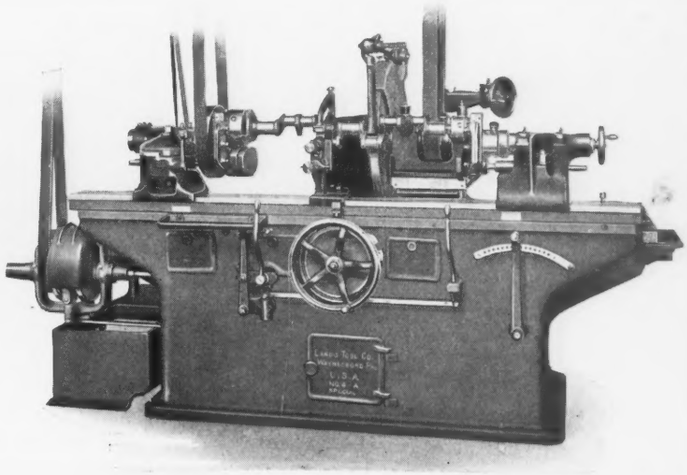
DOMESTIC AGENTS: Hallidie Machinery Co., Seattle; Harron, Rickard & McCone, San Francisco and Los Angeles; Seeger Machine Tool Co., Atlanta; Southern Machinery Sales Co., Houston.

CANADIAN AGENTS: F. F. Barber Machinery Company, Toronto; Williams & Wilson, Montreal; A. R. Williams Machinery Co., Nova Scotia, New Brunswick, Manitoba and British Columbia.

LANDIS



Landis No. 1 Universal Grinding Machine



Landis No. 4-A Special Grinding Machine

Leaders

class of grinding work; designed and built by experts to meet every demand of modern grinding methods.

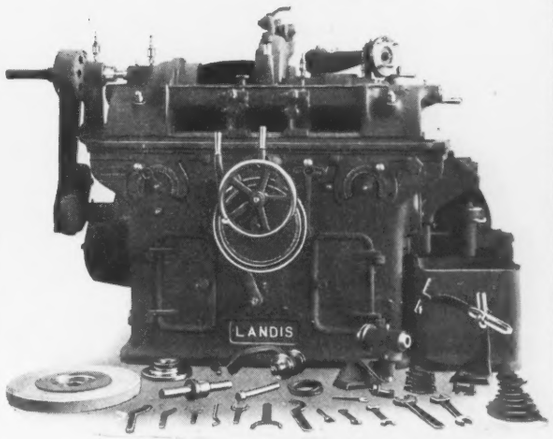
Landis Grinding Machines are always efficient, always profitable.

Send for a catalog. Get the details of all our machines.

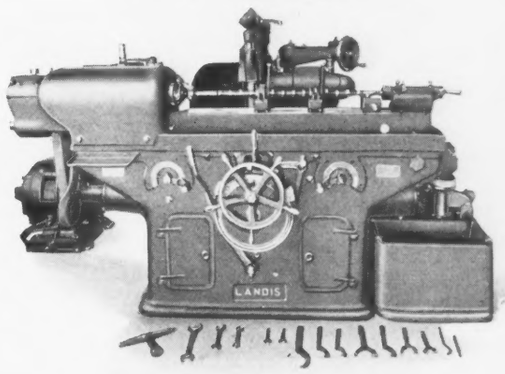
OL COMPANY

PENNA., U. S. A.

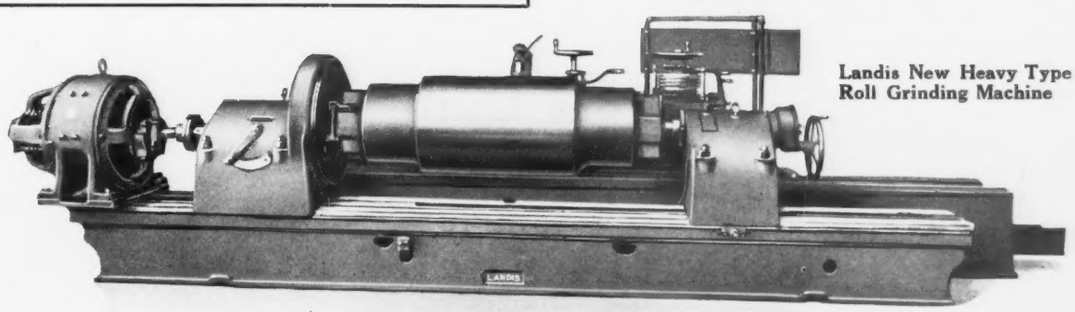
FOREIGN AGENTS: Allied Machinery Co., Paris, Turin, Barcelona, Brussels, Zurich and Lisbon; Andersen, Meyer & Co., Ltd., Shanghai; Andrews & George Co., Ltd., Tokyo; Benson Brothers, Sydney and Melbourne; Burton, Griffiths & Co., London; Wilh. Sonesson & Co., Ltd., Malmo and Copenhagen.



Landis Plain Grinding Machine



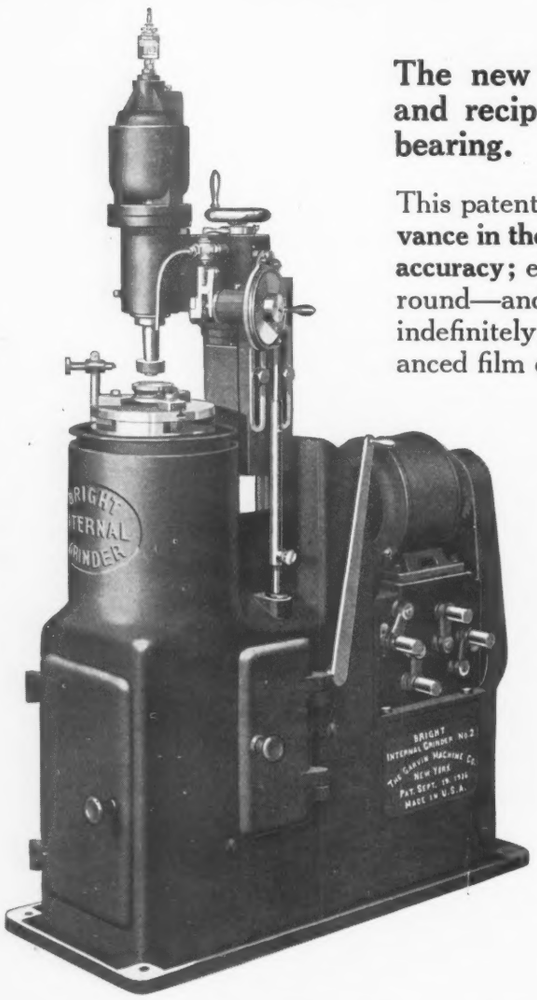
Landis Cam Grinding Machine



Landis New Heavy Type Roll Grinding Machine

GARVIN

It Compels Accuracy!



The new Bright Internal Grinder rotates and reciprocates the work spindle in one bearing.

This patent protected feature is the **first radical advance in the art of grinding in 40 years. It compels accuracy;** each hole must be absolutely straight and round—and not only when the machine is new but indefinitely. The work spindle is carried on a balanced film of oil—there is no wear.

There are many other points about this machine which mark it as absolutely the most efficient tool for its class of work.

You cannot ignore the cost saving that the Bright Internal Grinder puts at your command.

If you haven't already done so, write for the Catalog that describes it.

GRINDER SUGGESTION

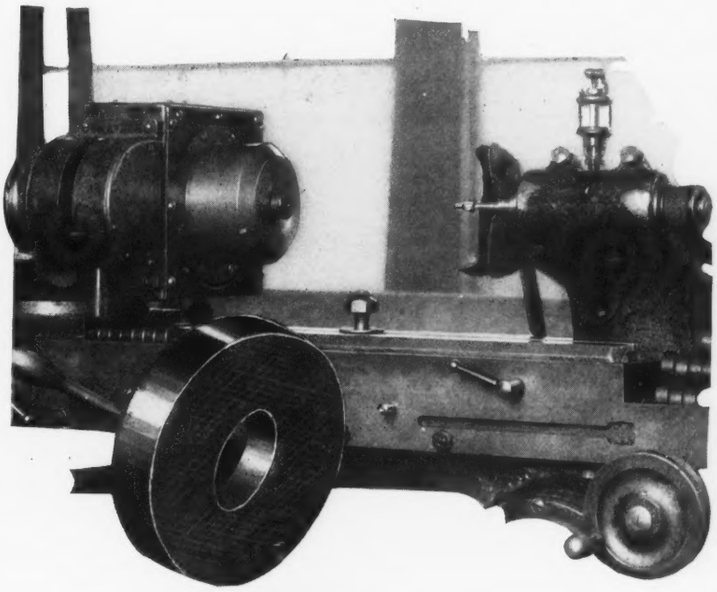
Duplex Drills
Duplex Mills
Bright Internal Grinders
Garvin Tappers
Screw Machines
Screw Slotters
Die Slotters
Hand Millers
Auto. Index Millers

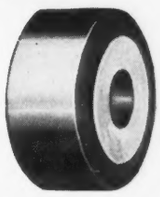
GARVIN

Spring Coilers
Production Millers
Universal Millers
Plain Millers
Vertical Millers
Slot Millers
Profilers
Cam Cutters
Bench, Cutter and Surface Grinders

The Garvin Machine Company,

Spring & Varick Streets
New York City





Cam Rolls

Rivett Grinders on Automotive Production

Many of the best known manufacturers of automobiles have found the Rivett No. 103 Internal Grinding Machine ideally adapted for grinding the holes in Cam Rolls. Some companies have wished to grind the hole to an absolute gauge fit. In such cases where no tolerance is allowed, production ranges from twenty to thirty holes per hour. In cases where a tolerance of .0005″ is allowed, production ranges from fifty to sixty holes per hour. If you have not yet solved the problem of grinding the holes in cam rolls or if you have other pieces in which you wish to grind holes accurately, at a rate of production consistent with accuracy, you should examine the merits of the Rivett No. 103.

Rivett Grinders in Automotive Tool Rooms

The precision of work in automotive production hinges largely on the accuracy of gauges and tools furnished the operators. Many tool rooms are equipped with Rivett No. 103 Internal Grinders for grinding gauges and holes in cutters, jig bushings, reamers and counterbores. If you wish to grind holes to close limits in your tool room, we suggest the installation of one or more Rivett No. 103 Grinders. Stocks of machines at the factory and in dealers' warehouses assure prompt deliveries.



RIVETT LATHE & GRINDER COMPANY

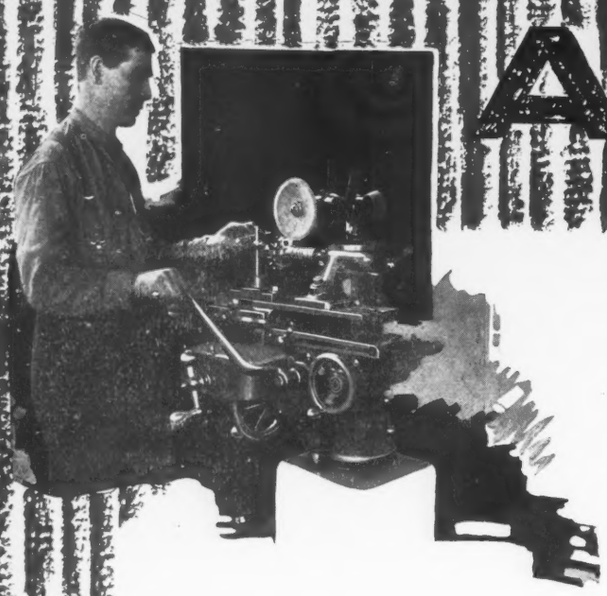
Builders of High Grade Precision Tools

Brighton District of Boston, Massachusetts

Branch: 642 Beaubien St., Detroit, Mich. Telephone, Cherry 7839

DOMESTIC AGENTS: The Fairbanks Company, New Orleans, La., Birmingham, Ala. Purinton & Smith, Hartford, Conn. Peter A. Frasse & Co., Inc., New York City. Homer Strong & Co., Inc., Rochester, Buffalo, Syracuse and Albany, N. Y. W. E. Shipley Machinery Company, Philadelphia, Pa. Somers, Fitler & Todd Co., Pittsburgh, Pa. Cleveland Tool & Supply Co., Cleveland, Ohio. E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind. National Supply Co., Toledo, Ohio. Dale Machinery Co., Inc., Chicago, Ill. Blackman-Hill-McKee Machinery Co., St. Louis, Mo. Portland Machinery Co., Portland, Ore. Hallidie Machinery Co., Seattle, Wash. F. O. Stallman Supply Co., San Francisco, Los Angeles, Cal. F. E. Satterlee Co., Minneapolis, Minn. Peden Iron & Steel Co., Houston, Texas. Smith-Courtney Co., Richmond, Va. Walraven Company, Atlanta, Ga. FOREIGN AGENTS: H. W. Petrie, Ltd., Toronto, Ont., Canada. Williams & Wilson, Ltd., Montreal, Canada. Fenwick Freres, Paris, France; Belgium, Switzerland, Italy, Spain, Portugal. Buck & Hickman, Ltd., London, Glasgow, Manchester, Sheffield, Birmingham. Benson Brothers, Sydney, Australia. Yamatake Company, Tokyo, Japan.

ALOXITE "AA"



The Wheel for t

The Aloxite "AA" wheel represents the greatest advancement in grinding wheels for tool-room work that has been made in years.

It is a wheel of unprecedented freedom of cut—a wheel that stays sharp, stands up to its work and cuts cool.

It is a wheel that responds admirably to the control of the operator taking light cuts or heavy cuts, within the range of practical tool-room work, without burning or distorting the piece. Another advantage in using Aloxite "AA" wheels is found in the fact that they can be made in very soft grades and still they will not wear away rapidly. Aloxite "AA" wheels will increase tool-room production because they will turn out better work —quicker.

It wasn't possible to make such an ideal tool-room wheel from the ordinary aluminous abrasive. Many months of exhaustive research and study told us this. The development of a new abrasive was necessary so Aloxite "AA"—the abrasive for tool-room wheels—was the result.

"A

The Carborundum Company, Niagara Falls, N. Y.

New York, Chicago, Boston, Philadelphia, Detroit, Cleveland, Pittsburgh



ALOXITE "AA"



the Tool-Room

This new abrasive is 98½ to 99 per cent pure alumina and its crystals are one hundred times larger than those of the average aluminous abrasive.

Because of the almost total exclusion of impurities from the abrasive grain, Aloxite "AA" wheels cut without drag or creating undue friction.

Because of the extraordinary size of the Aloxite "AA" crystals, each grain in the wheel is a definite fragment broken from the larger mass, thus assuring a grain with a sharper, cleaner fracture, again resulting in a cleaner, cooler cutting wheel.

Then, too, Aloxite "AA" wheels have an open, porous structure. Each grain gets a real chance to cut—to penetrate the work, removing the stock amazingly quick and leaving a uniform finish.

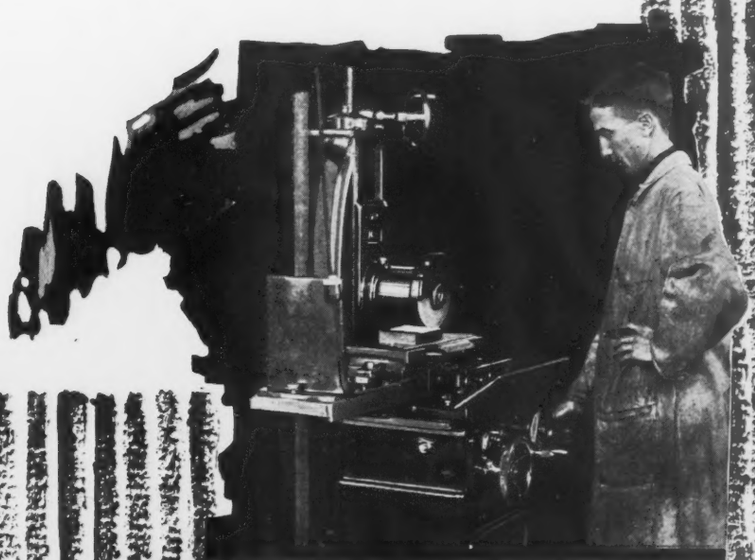
For the grinding of alloyed and high speed steel reamers, cutters, drills, hob mills, and similar tools, for work on hardened steel surfaces, for all of the internal work on bushings, bearings, gauges, etc., Aloxite "AA" is distinctively the wheel for tool-room work—a wheel of astonishing performances.

Try Aloxite "AA" in your tool-room. You have never had a wheel so genuinely efficient.

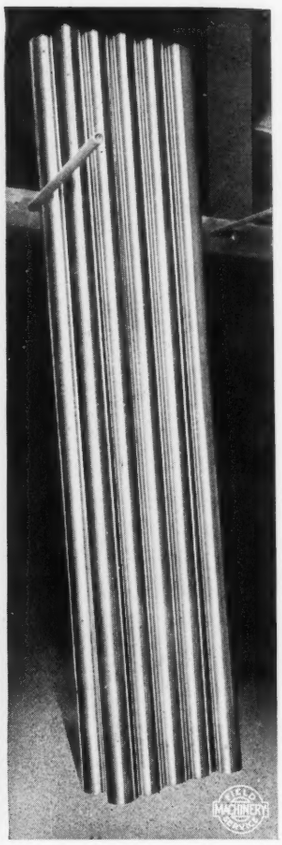
"AA"

The Carborundum Company, Niagara Falls, N. Y.

Cincinnati, Grand Rapids, Milwaukee,
Manchester, England.







"PRODUCTION"

POLISHING and FINISHING MACHINES

(Patented)

This machine will do all grades of cylindrical finishing from ordinary one pass work to the finest buffing on brass, etc., using special felt belts.

The centerless feed gives speed. Why not let us tell you what "Production" machines will do for you? Write for descriptive data.

PRODUCTION MACHINE CO.

GREENFIELD, MASS., U. S. A.

Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Cincinnati. Cadillac Machinery Co., Detroit, Mich. Marshall & Huschart Machinery Co., Chicago, Milwaukee. Allied Machinery Company of America, New York City, N. Y. (Export.)

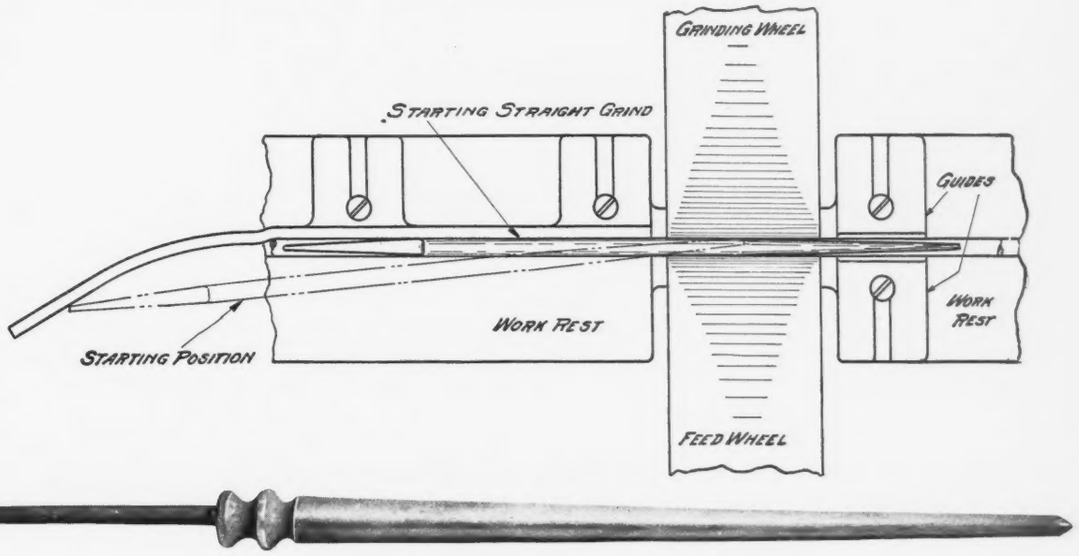
40 Seconds to Pass a 10 Foot Tube Through this Machine —No Centering, No Chucking —Just Feed Automatically

This is one of three "Production" Polishing and Finishing Machines in the Hartford, Conn., plant of the New Haven Sherardizing Company. The process of Sherardizing iron or steel consists in coating the metal with a zinc veneer to prevent rust and corrosion.

The New Haven folks do a lot of this work, particularly on tire formers for shaping and making inner tubes.

These moulds are made in various diameters from seamless steel tubing—those in the picture are 3¼" diameter by 10 feet long. They are placed in a channel guide and automatically fed against the surface of the swift-moving "Production" belt. The action rotates the tube and polishes at the same time. Different grit belts perform different polishing operations on each tube. It requires 40 seconds for a tube to go through the "Production" polisher once, and you get a uniform mechanical finish always the same—no chatter—no flats.

An Unusual Operation!



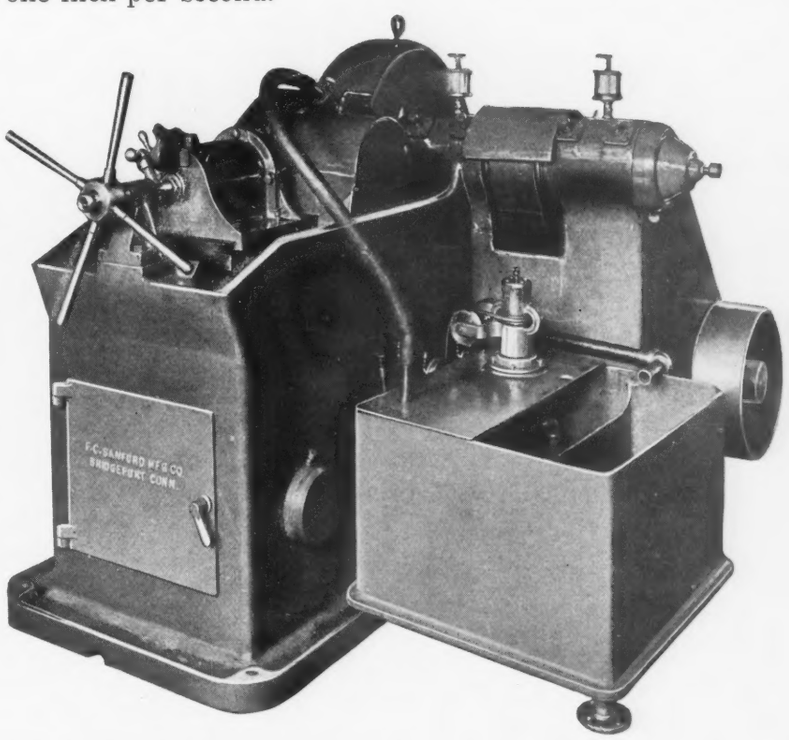
Grinding a Taper on the

Sanford Centerless Grinder

As the centerless grinder is usually recommended for grinding "circular parts of a single diameter," the grinding of a *tapered piece* on a standard type machine is worthy of particular attention. This soft steel knife sharpener blank is 8″ long, 7/16″ in diameter on the straight portion; .020″ to .025″ is removed and the piece is ground at the rate of one inch per second.

You will see by the drawing that the taper extends almost half the length of the piece and that the operation is quite simple and wholly practical. The result is an excellent example of the successful application of the Sanford Centerless Grinder to the economical performance of an unusual operation.

Let us give you details of this and other unusual operations profitably performed by these versatile production machines.



F. C. SANFORD MANUFACTURING CO., Bridgeport, Conn.

Walker Magnetic Chucks

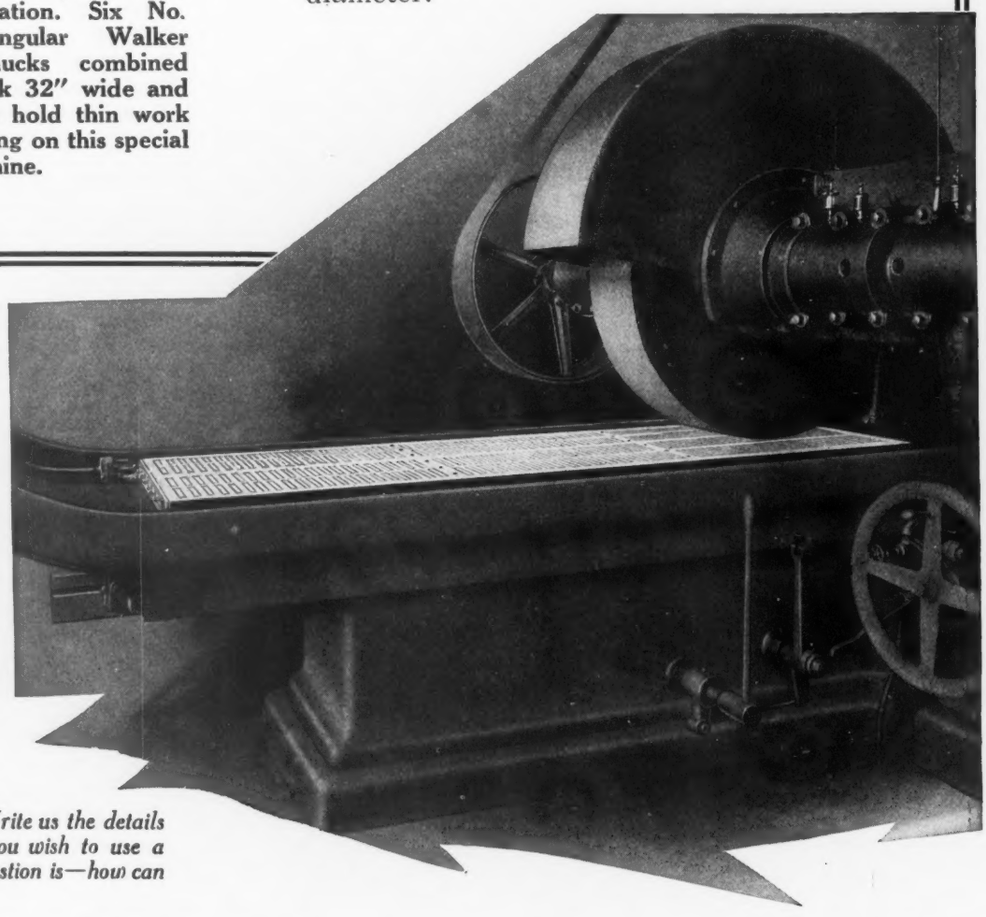
Adapted to or Developed for Your Needs

Many of today's standard rectangular type Walker Magnetic Chucks were developed first as "specials" to meet some particularly difficult chucking problem. Repeated demands have placed them on the standard list. So the line has increased, including chucks for an ever widening range of work.

Tell us your chucking problem; a very slight change may adapt a standard chuck to your very need; if not, our engineers will design a new one to fill the bill. It's the way we grow. We know, and our customers know, that the *principle is right!* The successful solution of many chucking problems has given us the knowledge and experience to make Walker Magnetic Chucks indeed the "Best Way to Hold Most Work, the Only Way to Hold Some of It."

We also manufacture a line of Rotary Type Magnetic Chucks ranging from 6″ up to 42″ diameter.

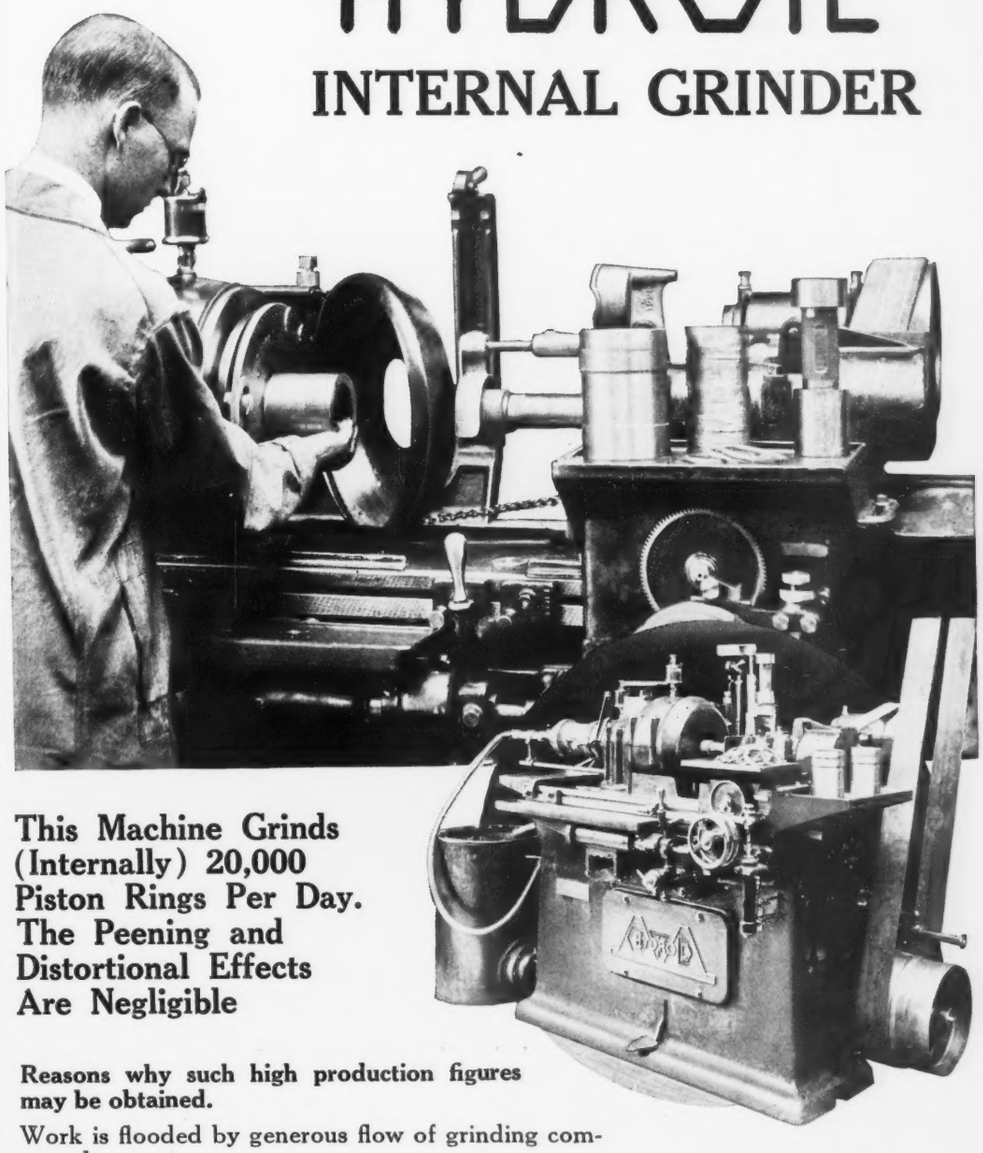
An excellent example of successful adaptation. Six No. 1636 Rectangular Walker Magnetic Chucks combined into one chuck 32″ wide and 108″ long to hold thin work for fine finishing on this special grinding machine.



Send for our Catalog. Write us the details of the work on which you wish to use a Walker Chuck. The question is—how can we help you.

O. S. WALKER CO., Inc., Worcester, Mass.

"HYDROIL"
INTERNAL GRINDER



This Machine Grinds (Internally) 20,000 Piston Rings Per Day. The Peening and Distortional Effects Are Negligible

Reasons why such high production figures may be obtained.

Work is flooded by generous flow of grinding compound.

Work head and wheel head have large bearings.

The wide belt is capable of transmitting as high as 20 H.P. to grinding wheel spindle.

Water guard or door automatically opens when the control lever sends the table to the extreme left. In this position the work may be gaged or chucked.

A hydraulic ram holds the work in place and ejects it when the iris shutter is opened.

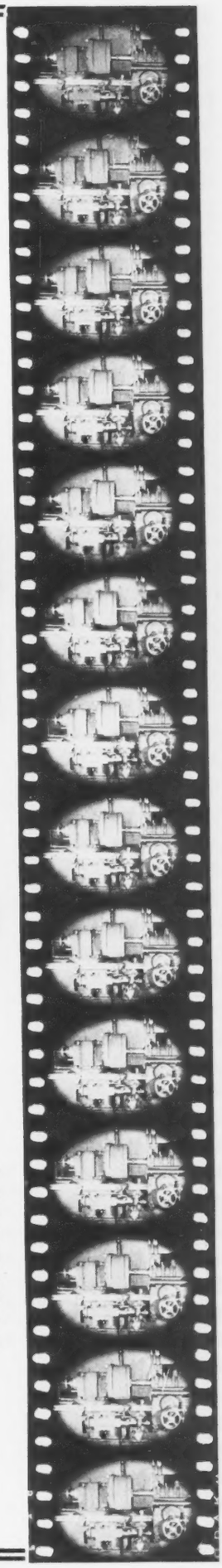
The wheel guard drops into place when the plug gage is removed from the cup.

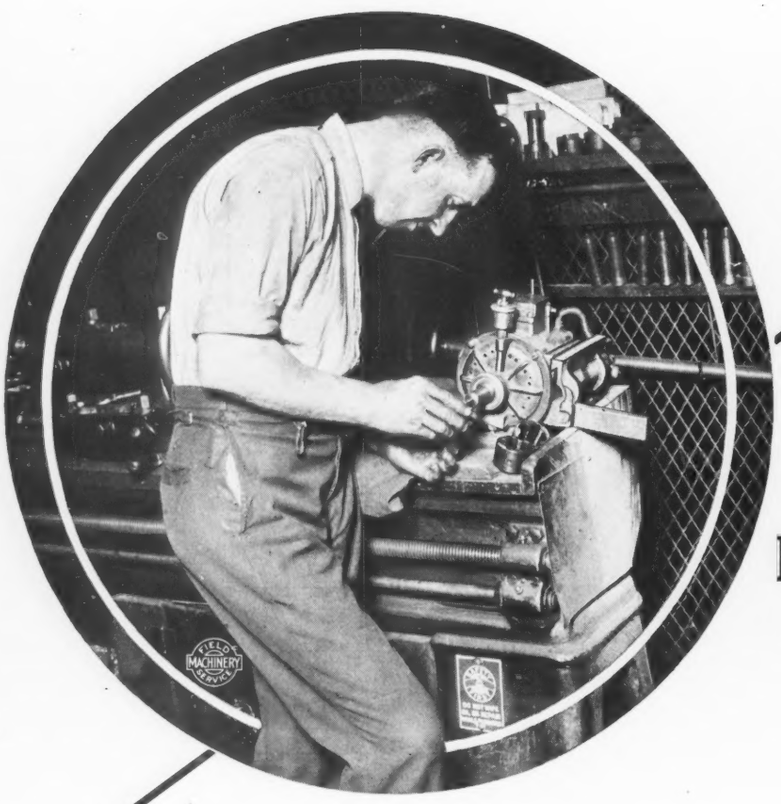
The diamond bridge swings into a vertical position at the back of machine.

REG. U.S. PAT. OFF.
GTD HYDROIL

Would you care to have one of our Sales Engineers call at your plant and show a motion picture of this machine in action? He will gladly go over your internal grinding operations and explain the cost reduction possible with the "Hydroil." Circulars may be had on request.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASSACHUSETTS

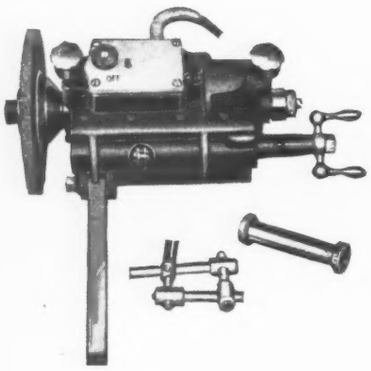




ELECTRICALLY DRIVEN GRINDERS

Are Fully Self-Contained

Railroad Shops Find Profit in U. S. "Portables"



U. S. Portable Electrically Driven Drills and Grinders are fully described in Catalog No. 20.

Until the installation of this small, electrically driven toolpost grinder, two years ago, practically all odd jobs of grinding, both large and small, were performed on a universal grinder, in the big railroad shop where this picture was obtained. Since then much of this work has been more quickly and more economically handled by the U. S. "Portable" in addition to the work for which it was originally installed—i. e., grinding the flutes on special solid round thread cutting dies after hardening, and sharpening both flutes and chamfer again and again as they grow dull.

Owing to the design of these dies—which are made in the shop tool room, for use on automatic screw machines—no method of sharpening had previously been found. Many had, therefore, been consigned to the scrap heap and maintenance costs were correspondingly high. The U. S. "Portable" put an end to this waste.

THE UNITED STATES ELECTRICAL TOOL CO.

6th Avenue and Mt. Hope Street — CINCINNATI, OHIO

NEW YORK CITY · BOSTON · PHILADELPHIA · ST. LOUIS · CLEVELAND · DETROIT · CHICAGO · KANSAS CITY · MILWAUKEE · HOUSTON, TEXAS · NEW ORLEANS · PITTSBURGH, PA.

FITCHBURG GRINDING MACHINE CO.

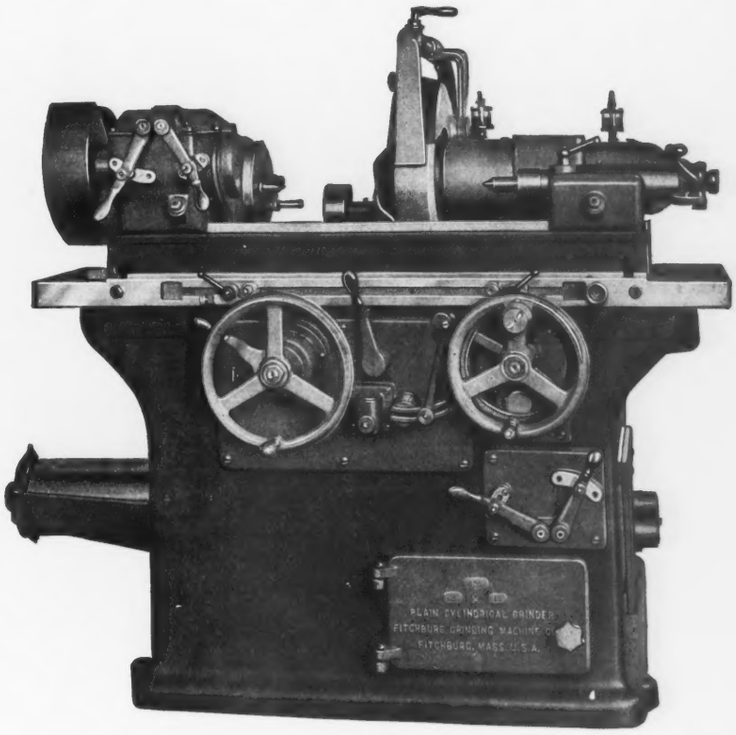
FITCHBURG, MASS., U.S.A.

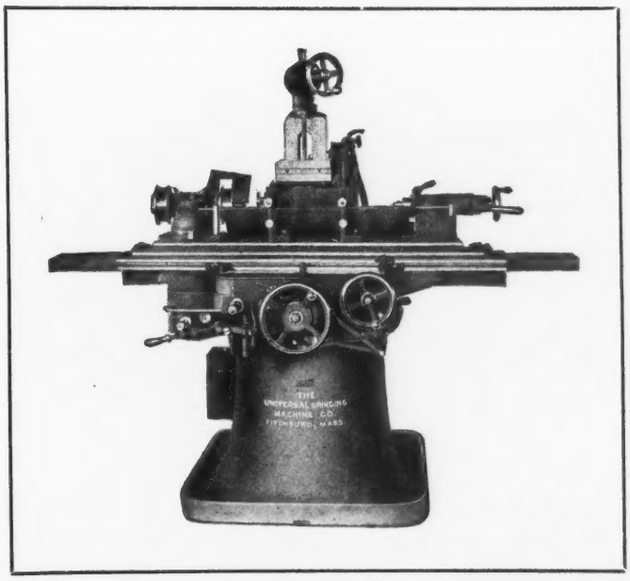
Fitchburg 8"x20" Plain Cylindrical Power Feed Grinding Machine.

Also made

4" and 12"x20"
8" and 12"x36"
8"x54"
12"x54"

Power Feed or Hand Operated and self-contained for single pulley or electric motor drive.





Bath Universal Grinding Machines for Cylindrical, Surface, Internal, Disc, Tool and Cutter Grinding.

Built in Three Sizes:

No. 1, 10"x20" using wheel 10"x ¾"
No. 2, 10"x25" using wheel 12"x 1½"
No. 2½, 10"x36" using wheel 12"x 1½"

UNIVERSAL GRINDING MACHINE CO.

FITCHBURG, MASS., U.S.A.

CINCINNATI

PORTABLE ELECTRIC TOOLS

GRINDERS

BENCH—FLOOR—TOOL POST—AERIAL

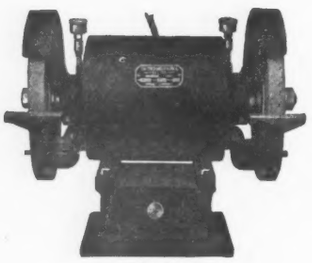
The greatly increased use of portable electric grinders shows that this type of grinding machine is the most economical on a host of jobs. The greatly increased sale of "Cincinnati" Portable Electric Grinders shows that this make is the recognized leader in the field.

Catalog sent on request.

THE CINCINNATI ELECTRICAL TOOL CO.,

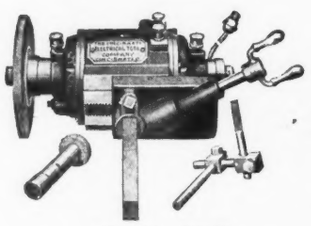
1507 Freeman Avenue — Cincinnati, Ohio

New York, 50 Church Street
Detroit, Murphy Bldg.
Philadelphia, 1220 Real Estate Trust Bldg.
Los Angeles, 510 Equitable Bldg.
Chicago, 518 Peoples Gas Bldg.
San Francisco, 918 Hearst Bldg.



Bench Grinder
In ½, 1, 2 and 3 H.P.

Used throughout the world since 1902



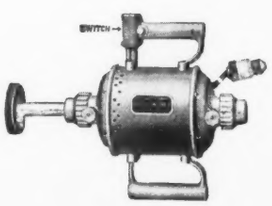
Tool Post Grinder
In ¼ and ½ H.P.



Aerial Grinder
½ and 1 H.P.



Floor Grinder
½, 1, 2 and 3 H.P.



Hand Aerial Grinder
In ¼, ½ and 1 H.P.

Once More BESLY Grinding Beats Milling

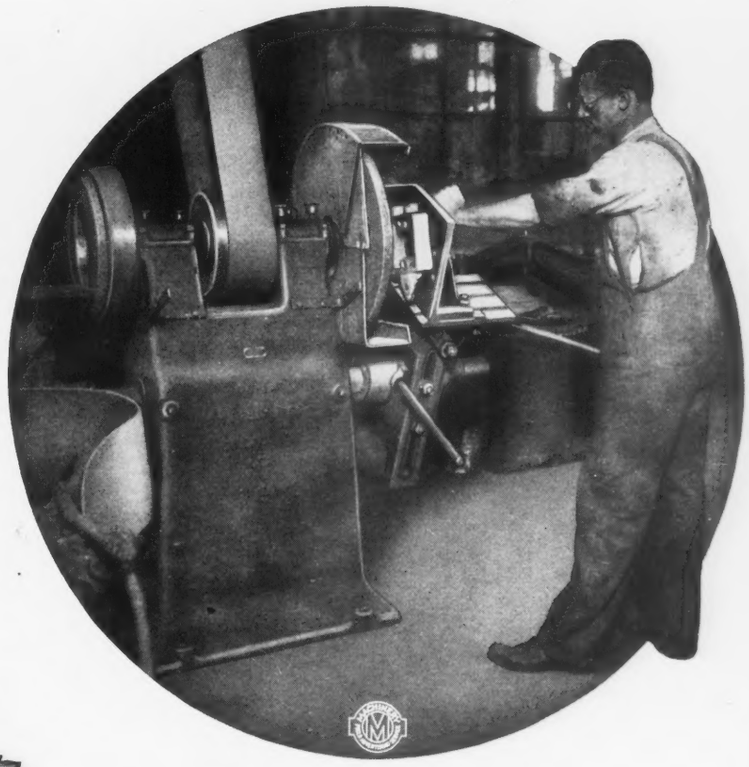
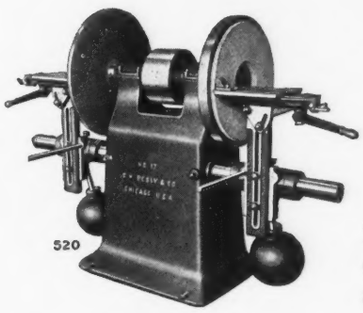


Photo and data concern the production problems at Platt Iron Works, Dayton, Ohio, where the application of Besly Grinding is being extended as fast as is practicable.



Six to One

is the latest official record of its output as compared to milling on the valve decks for steam pumps here shown in process of grinding. This is a surfacing job and not more than eight to ten per hour were produced on the miller, whereas the "Besly" tripled production at the first go and soon showed that 60 per hour was a reasonable output to expect.

This machine has been four years at the Platt Works where additional "milling" jobs are being transferred to the grinding department as fast as the simple fixtures necessary can be designed and built. Many require no fixtures at all, for the Besly Geared Lever Feed Table (Patented) with which the machine is equipped has many features which facilitate setting up without further equipment—among them a highly sensitive hand feed adjustable by micrometer stop screws graduated to .001″. Top of table may be tilted 30° from horizontal and has vertical adjustment as well. It is provided with T-slots and may be further equipped with angle plates and a Universal Bevel Protractor.

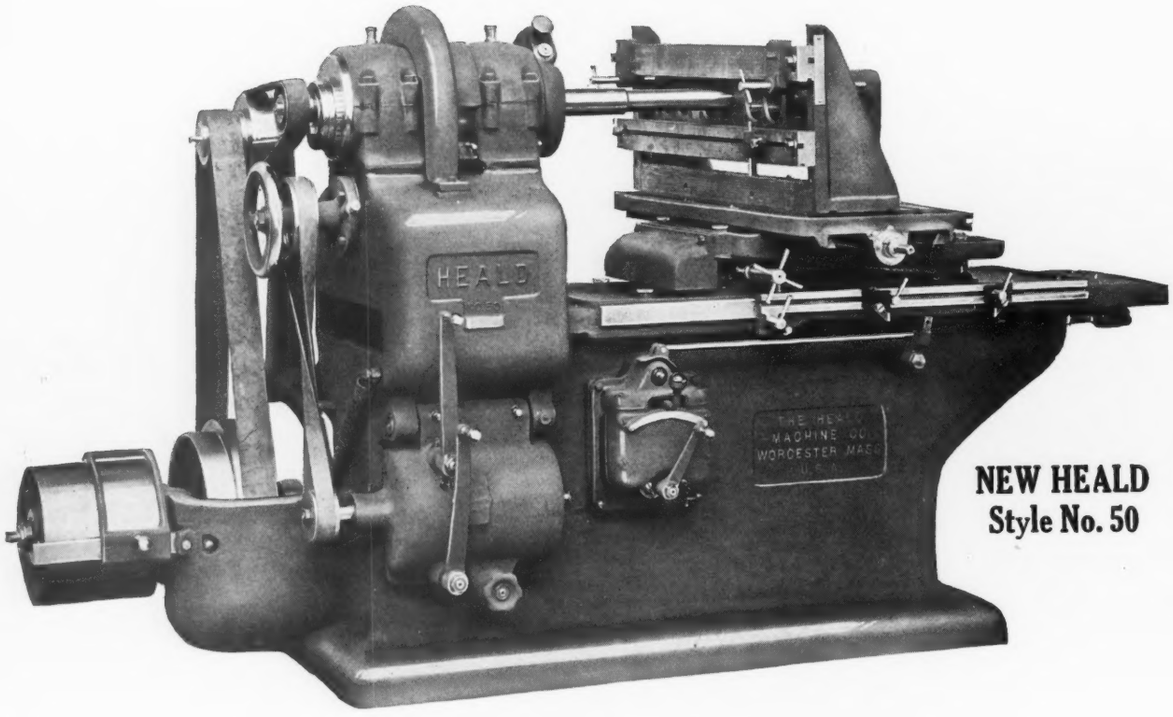
Besly Grinders require no skill to operate — another saving to their credit—and maintenance cost is negligible. Details in Catalog—Advice on receipt of specifications or samples of "that expensive job."

BESLY
CHICAGO

CHARLES H. BESLY & COMPANY

120-B N. CLINTON STREET **CHICAGO, ILL., U. S. A.**

Buyers of Motor Cars Now



NEW HEALD
Style No. 50

Simple – Massive—Large Capacity—Practically Gearless —Unlimited range of speeds for the table which can be reversed or stopped at any point without shock or noise.

The general buying public and motor mechanics are fast becoming thoroughly educated and convinced of the merits of a ground cylinder in comparison with one that has been bored and reamed. Sales agents everywhere have found that the preference is for cars with ground cylinders.

While it is a well-known and accepted fact that all high grade auto manufacturers finish their cylinders by grinding, few realize how many of the less expensive car builders are also using this operation to give greater efficiency to their motors.

Such manufacturers as Dort, Essex, Gardner, Grant, Hupmobile, Jewett, Rickenbacker, etc., have long realized its advantages and now find it to be a big factor in their sales arguments. Taking all the car manufacturers, both pleasure and commercial, about 90% finish their cylinders by grinding.

THE HEALD MACHINE COMPANY, 16 New

BRANCHES: New York, 839 Singer Bldg.; Philadelphia, 1302 Stephen Girard Bldg.; Chicago, 26 South Jefferson St.; Detroit, 400 Marquette Bldg.; Cincinnati, 705 Provident Bank Bldg.; Cleveland, 721 Engineers Bldg.; St. Louis, 710 Pontiac Bldg.; Milwaukee, 947 41st St.
AGENTS: Eccles & Smith Co., 69 First St., San Francisco, Calif. Eccles & Smith Co., 241 S. Los Angeles St., Los Angeles, Calif.. Eccles & Smith Co., 46 Front St., Portland, Oregon. Eccles & Smith Co., 309 Maynard Bldg., Seattle, Wash. Salt Lake Hardware Co., Salt Lake City, Utah. The Russell Hardware Co., McAlester, Okla. F. E. Satterlee Co., 118-120 Washington Ave., N., Minneapolis, Minn. G. Norman Baughman Co., Florida Ave. and Jackson St., Tampa, Florida. Young & Vann Supply Co., 1725-31 First Ave., Birmingham, Ala. Oliver H. Van Horn Co., 518 Camp St., New Orleans, La. The Walraven Co., 36-38 West Alabama St., Atlanta, Ga. Greensboro Supply Co., Greensboro, N. C. Smith-Courtney Co., Richmond, Va. Krueger Machinery Co., San Antonio, Texas. Crow-Burlingame Co., Little Rock, Ark. The Faeth Co., 1117 West Eighth St., Kansas City, Mo. Western Automobile Supply Co., Omaha, Neb. George F. Foss Machinery Co., 305 St. James St., Montreal, Canada. H. W. Petrie, Ltd., 131-147 Front St., West, Toronto, Ont. Hamilton Machinery Co., 204-208 Market St., Chattanooga, Tenn. South Western Sales Co., Phoenix, Arizona.

Insisting on Ground Cylinders

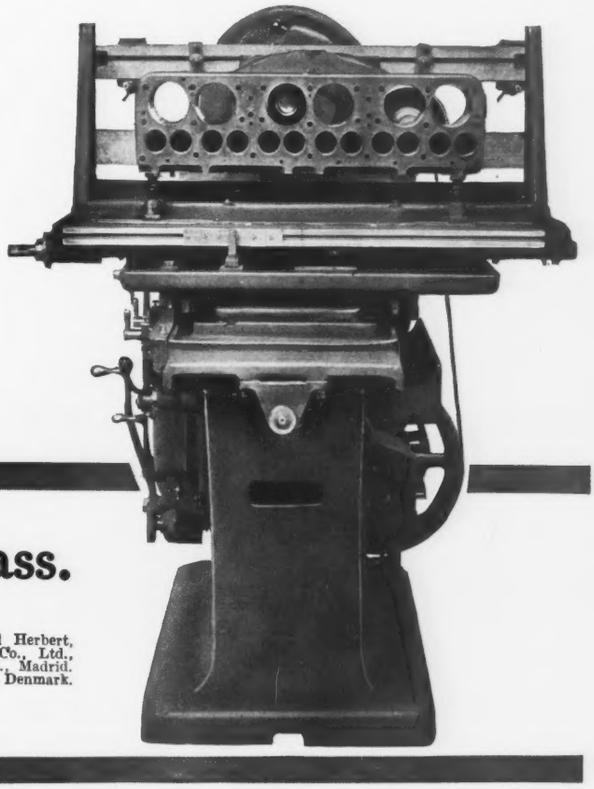
It is interesting to note that Chandler have just equipped with Heald machines and will hereafter furnish motors with ground cylinders.

Undoubtedly a good share of the reason why the public is insisting on ground cylinders is due to the fact that there are 1400 Heald machines in this country doing nothing but regrinding and fitting new pistons and rings. This has without question been a tremendously big item in educating motor owners to the advantages of ground bores in regard to economy and efficiency of operation, and is especially true with those whose cylinders were originally bored but have been reground for they can more easily appreciate the difference.

Level-headed engineers and mechanics in such plants as Rolls-Royce, Packard, Pierce Arrow, Cadillac, Locomobile, Peerless, Stutz, Winton, Cunningham, etc., realize that only by grinding can a true, round hole be obtained and one which will be absolutely at right angles to the flange, giving a perfect bearing to the piston.

They have also unanimously agreed upon the Heald Machine as the best to do this work. Heald machines have been for seventeen years used expressly for grinding cylinders and the latest model, Style No. 50, is especially desirable for manufacturing purposes. It is unusually heavy and rigid, self-contained, with an hydraulic drive for the table enabling the operator to get any speed, from nothing up to the maximum, or can be reversed and stopped at any point without shock or noise.

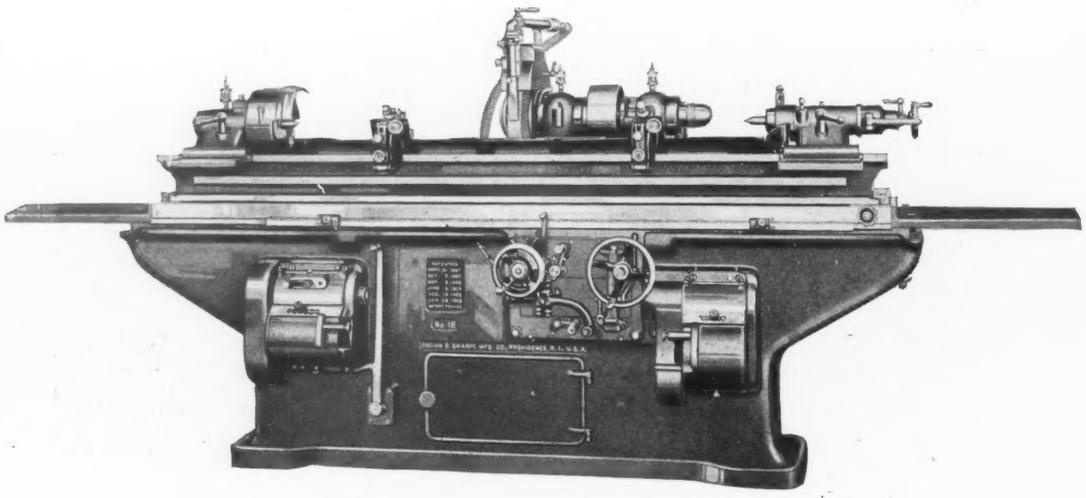
The illustration below shows the Heald No. 50 grinding the bores of a Hudson Super-six. Note the massiveness of the bed and width of the table.



We would like to furnish you with a bulletin fully explaining the new Heald Machine. How many shall we send to take care of all your interested executives?

Bond Street, Worcester, Mass.

FOREIGN AGENTS: Alfred Herbert, Ltd., England. Societe Anonyme Alfred Herbert, France, Switzerland. Societa Anonima Italiana, Alfred Herbert, Italy. Horne Co., Ltd., Japan. Henri Benedictus, Brussels, Belgium. American Mchy. Syndicate S. A. E., Madrid. Sindicato de Maquinaria Americana, Bilbao, Spain and Portugal. Oscar Ericsson, Denmark. Messrs. Carrick-Wedderspoon, New Zealand.



BROWN & SHARPE PLAIN GRINDING MACHINES

A new angle on the Economy of Grinding

Quantities of jobs demanding either high accuracy or smooth finish and now being completed on automatics or turret lathes can be finished with greater economy by grinding.

By giving pieces an allowance for grinding, production is increased on the automatics, turret and engine lathes which are no longer held to the feeds and speeds necessary for high accuracy and smooth finish.

The grinding machine keeps pace with this increased production and turns out smoother, more accurate work than can be secured by other methods.

Thus Quantity is increased and Quality improved by finishing work on a grinding machine.

For a truer surface, more uniform size, and a smoother finish at less cost use Brown & Sharpe Grinding Machines.

Send for Catalog No. 137 describing our complete line of grinding machines.

BROWN & SHARPE MACHINISTS' TOOLS

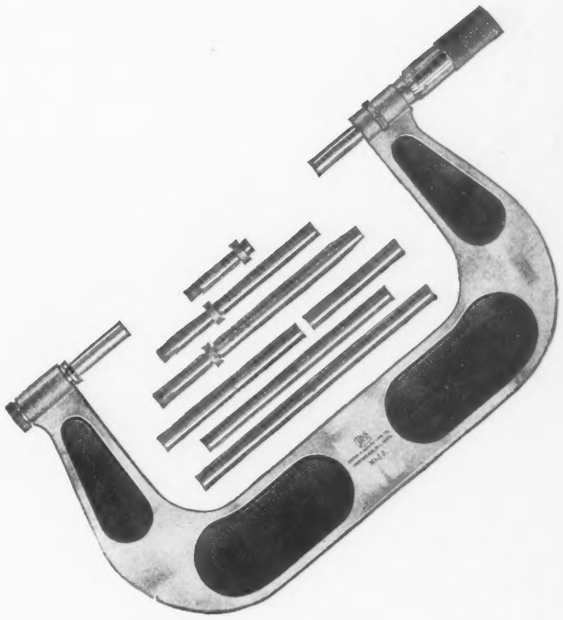


The quantity production of extremely accurate work, made possible by the grinding machine, gives added importance to the use of Brown & Sharpe Machinists' Tools, particularly the micrometer caliper.

By measuring with this tool, the operator learns the exact size of the work. Knowing the size to a thousandth or (with some types of micrometers) to a ten-thousandth of an inch, he can readily estimate the precise amount to be removed. The use of a micrometer to check the size of the work practically eliminates the chance of grinding off too much material.

A new micrometer covering a wide range of sizes

The new No. 55 Micrometer Caliper, shown below, is designed to measure from 2 in. to 6 in. in thousandths of an inch. Interchangeable anvils are used to secure this wide range, one anvil covering measurements from 2 in. to 3 in., another from 3 in. to 4 in. and so on. Manufacturers whose work includes a wide range of sizes will welcome the introduction of this new tool whose capacity equals that of a set of four micrometers usually necessary to cover the range of this one tool. This is a very handy micrometer for the repair department of a sizeable plant or for the small shop with a variety of work requiring careful measurement.



Write for Catalog No. 28 describing 2000 tools.

BROWN & SHARPE MFG. CO.

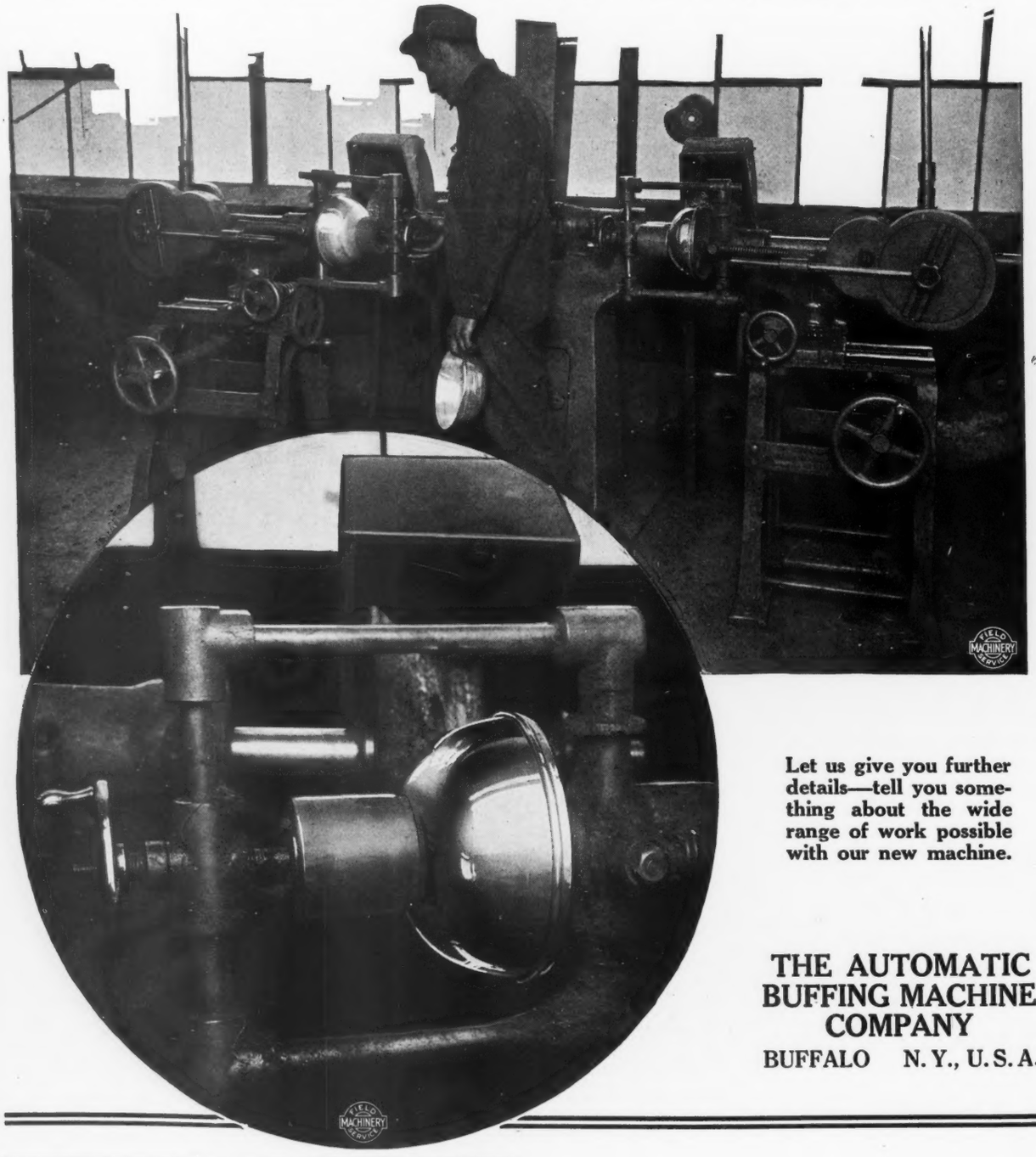
Providence, R. I., U. S. A.

AUTOMATIC BUFFING MACHINES

Eighteen—Busy All the Time

Competition is keen in the aluminum ware business and every saving in production costs means lower prices and better sales. In this case the Automatic Buffing installation has not only reduced manufacturing expenses and about doubled production, but has improved the quality of work.

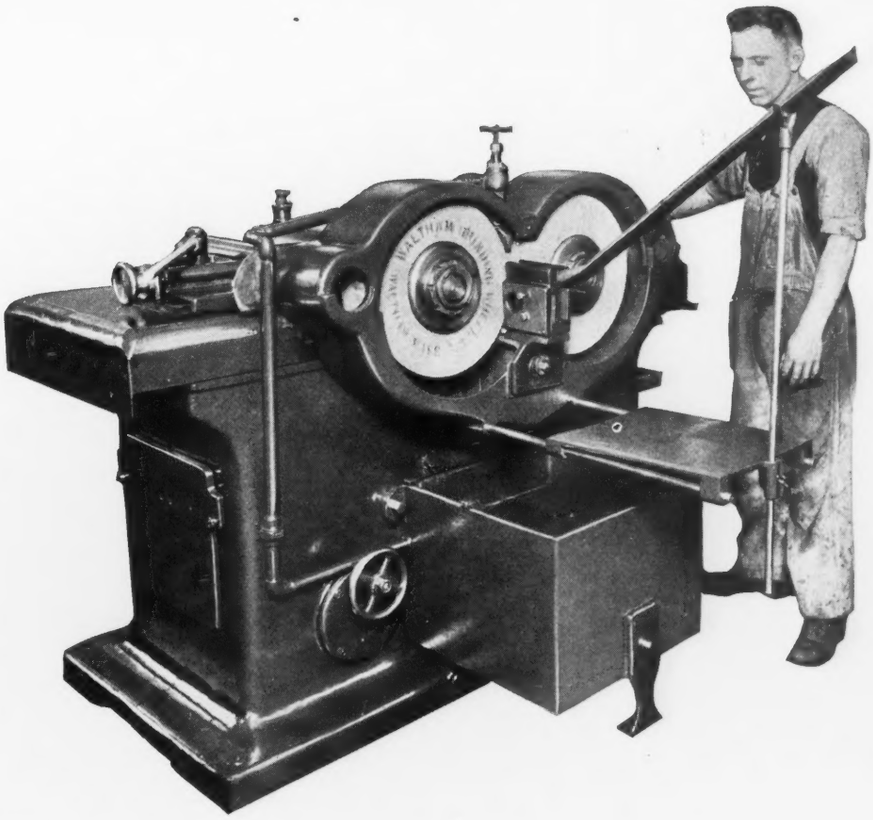
The work shown is a colander—output 800 in 9½ hours—one operator, two machines.



Let us give you further details—tell you something about the wide range of work possible with our new machine.

THE AUTOMATIC BUFFING MACHINE COMPANY
BUFFALO N. Y., U. S. A.

HEIM CENTERLESS CYLINDRICAL GRINDER



Taking the Industry by Storm

The Heim Centerless Cylindrical Grinder has captured the country. Heim performances did it. Take your pencil and convert these facts into terms of dollars and cents. Then you'll begin to realize the need of Heim equipment in your plant.

The Heim positively increases production 50 to 500 per cent. It turns "lost time" into output. On short run work as well as on quantity production it shows the same results. As few as 25 pieces may be profitably handled on the Heim.

And here's another eye-opener. Heim Grinding Wheels are trued in 5 seconds, by the watch. You do not have to remove the work or disturb the guide plates. The set-up stays put. The Heim way of truing wheels helps you to do eight hours actual grinding in eight hours' time. Write for the Heim story.

THE BALL AND ROLLER BEARING COMPANY

DANBURY, CONN., U. S. A.

A. C. S. Cylinder Grinding Attachment

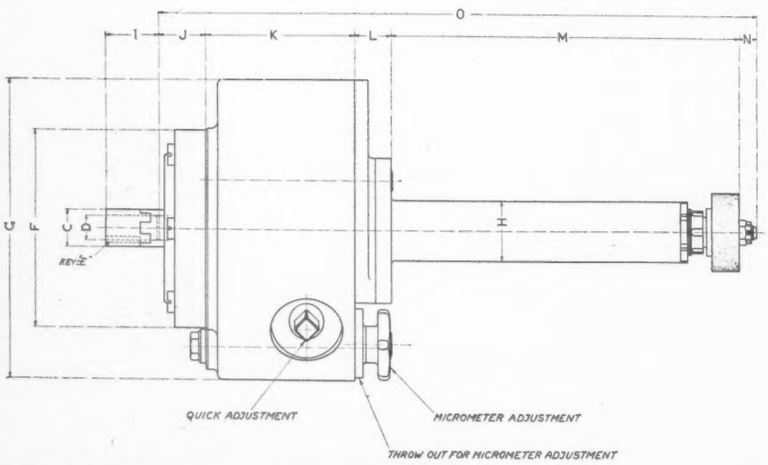
For Lathes and Milling Machines



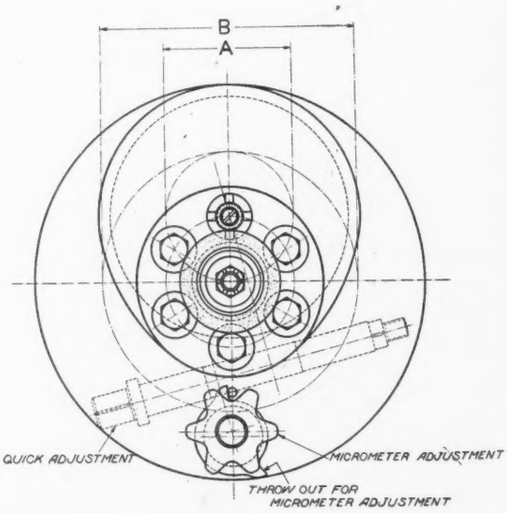
$350.00

Complete with Counter Shaft and Blower

The A. C. S. Cylinder Grinding Attachment for Lathes and Milling Machines naturally finds its readiest application in job shops and garages for the re-grinding of automobile, truck, tractor and marine engine cylinders. In shops where re-boring of steam engine, pump, air compressor or refrigerating machine cylinders is done on a lathe with the work bolted to carriage, or where awkward work, too cumbersome for turning, is bored with a bar between centers, the A. C. S. is indispensable. It can be mounted on the machine spindle and the job perfectly ground at the same setting. Because of its enormous throw or eccentricity very large holes can be ground as readily as small.



ATTACHMENT	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
№ 1	3½	7	1⅝	⅜	4×⅝	7	10½	2⅛	1⅛	1⅛	5⅜	1⅛	12½	⅜	2⅛
№ 2	4	8	1½	1	4×¾	7	12	2⅜	2⅜	2	5⅜	1⅜	13½	⅜	2⅜



SINCLAIR ENGINE & FOUNDRY CO., Inc.

NEW ORLEANS, U. S. A.

EC OMY **ECONOMY** EC OMY

TRADE MARK REG. U.S. PAT. OFF.

GRINDING LUBRICANT

"Economy" Clinches All Arguments

This "close-up" in a famous motorcycle manufacturing plant shows the internal grinding of clutch pinions. A ¾" hole is being ground to size. The grinding wheel is ⅝" diameter and to attain a suitable surface speed it naturally makes more revolutions than would a larger wheel. It is also true that any given point on the wheel makes contact with the work more often than any point on a larger wheel. There is more wear with the small wheel and therefore greater tendency to clog; *but it does not clog* for the Grinding Lubricant is "Economy."

"Economy" is the efficient lubricator. It prevents clogging. It keeps the wheel and work cool. It earns its name by its thrift. This is not an isolated case—"Economy" will do as much for you as it does for others.

Write for Particulars

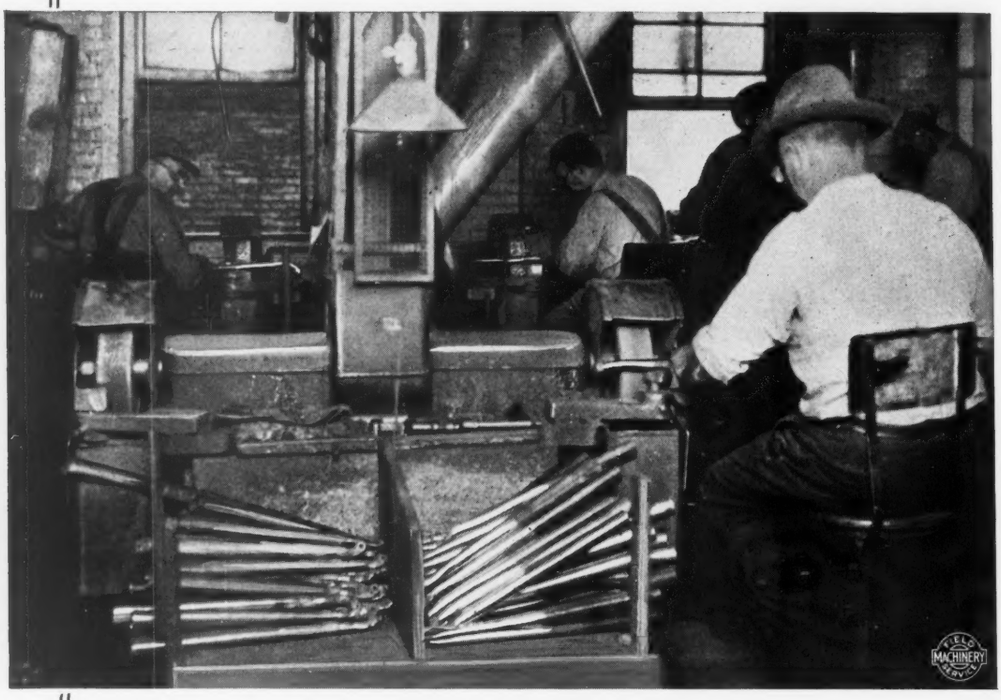
THE WHITE & BAGLEY COMPANY

Worcester Mass., U. S. A.



Divine Polishing Service



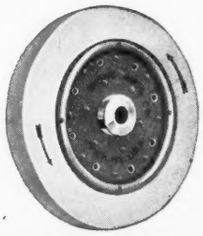


Finishing Top-Bow Sockets

The Brewer-Titchner Corporation, Binghamton, N. Y., manufactures automobile hardware. Among its products is the bow socket for one-man type automobile tops. Compare the quality of this socket with the article used a few years ago on five and six-bow tops. Brewer-Titchner has achieved a triumph in this socket. It is made in two pieces. One piece is No. 20 gage sheet steel formed to the desired cornucopia shape, and the other a steel forging. The two are welded together.

In a welding operation of this character there is considerable surplus metal and scale on the surface. This must be removed and that is just where *Divine Brothers' Polishing Service* comes in. For 5 years ten spindles in this shop have been equipped with Divine Wheels—14″, compress canvas, charged with grain 36 alundum. Production is fast and the work high-grade.

Let us tell you more about Divine Polishing Service.



DIVINE POLISHING SERVICE

Divine Polishing Service consists of:—

1—*Studies of polishing problems of all kinds.*

2—*Recommendations* based on thirty years' engineering experience.

Everything For The Polishing Room

Engineering Department

DIVINE BROTHERS COMPANY, Utica, N. Y.

Metal Finishing Engineers

—And All the Way Between

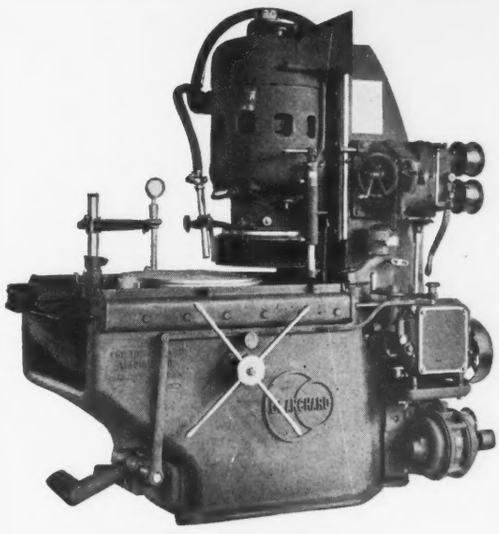
The Blanchard Grinder, almost since its inception, has been used for grinding ball races. This industry was one of the first to realize the production possibilities of the Blanchard Grinder; and now, there is scarcely a concern which manufactures ball or roller bearings and does not use this machine.



Roller Race 21½" O. D.

These small ball races are ground 875 at a time upon the 26" one-piece steel magnetic chuck.

One man operating the machine produces 700 pieces per hour; but, with improved facilities for washing and handling, one man and helper turn out 3600 pieces (7200 surfaces) per hour.

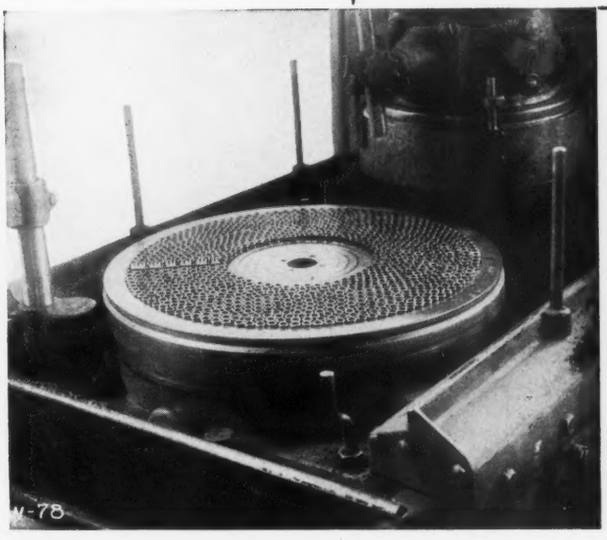


No. 16 Blanchard
High Power Vertical Surface Grinder
Direct Motor Drive Type

This story is not complete unless the new No. 16 Blanchard Automatic Surface Grinder is mentioned. This new machine, illustrations of which are not yet available, is designed for large quantity production of pieces 6" diameter or smaller.

On rings of medium size, the Automatic with one operator produces approximately twice as many pieces per hour as the standard No. 16 Blanchard Grinder with operator and helper.

Ball Race ⅝" O. D.



A Better Product for less Money

The Blanchard Machine Company

64 State Street
CAMBRIDGE, MASS.

REPRESENTATIVES: UNITED STATES: Henry Prentiss & Co., Inc., Motch & Merryweather Mchy. Co., Marshall & Huschart Mchy. Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Berger & Carter Company, The Hendrie & Bolthoff Manufacturing & Supply Co. CANADA: Williams & Wilson, Ltd., F. F. Barber Machinery Co., GREAT BRITAIN: C. W. Burton, Griffiths & Co. FRANCE: Aux Forges de Vulcain. ITALY, SWITZERLAND, BELGIUM, SPAIN and PORTUGAL: Allied Machinery Co. of America. SWEDEN: A. B. Rylander & Asplund.

FAFNIR

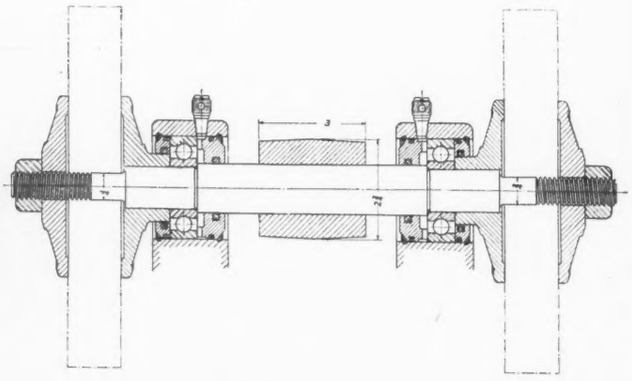


Fafnir Ball Bearing Tool Grinders are made to run all the time—right from the main line.

You know how it is with tool grinders;—everybody uses them, nobody takes care of them, but everybody kicks if they aren't in good condition. They are usually left running, almost never oiled, the bearings wear and they become an infernal nuisance.

You can relieve yourself of all this trouble and worry by buying *Fafnir Ball Bearing Tool Grinders.* The spindle is mounted on alloy steel *Fafnir Ball Bearings.* They are designed to be run constantly from any line of shafting without counters or loose pulleys; they require only a few drops of oil once in several weeks, and will last indefinitely.

Our new catalog of *Fafnir Industrial Ball Bearings* is now ready for distribution.



FAFNIR
The Red Dragon Line

THE FAFNIR BEARING COMPANY

Conrad Patent Licensee

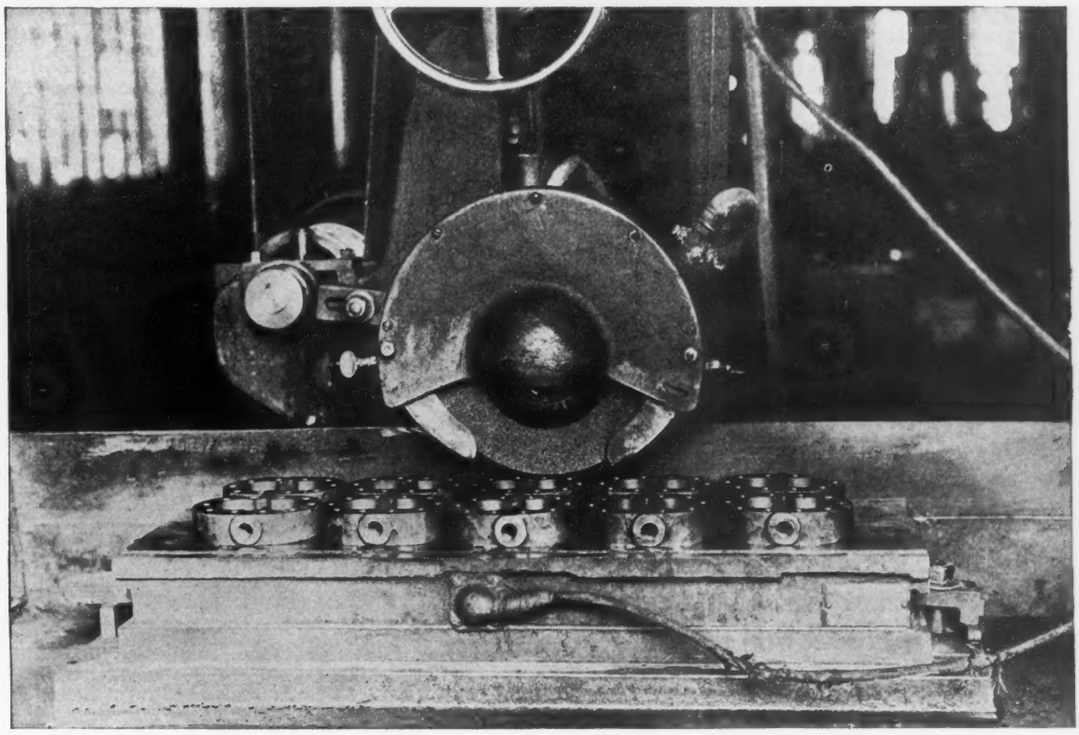
DETROIT Office: 752 David Whitney Bldg.
CLEVELAND Office: 1016-1017 Swetland Bldg.

New Britain, Conn.

CHICAGO Office: 537 So. Dearborn St.
NEW YORK Office: 5 Columbus Circle.

Grinding Metal-to-Metal Joints on a

DIAMOND SURFACE GRINDER



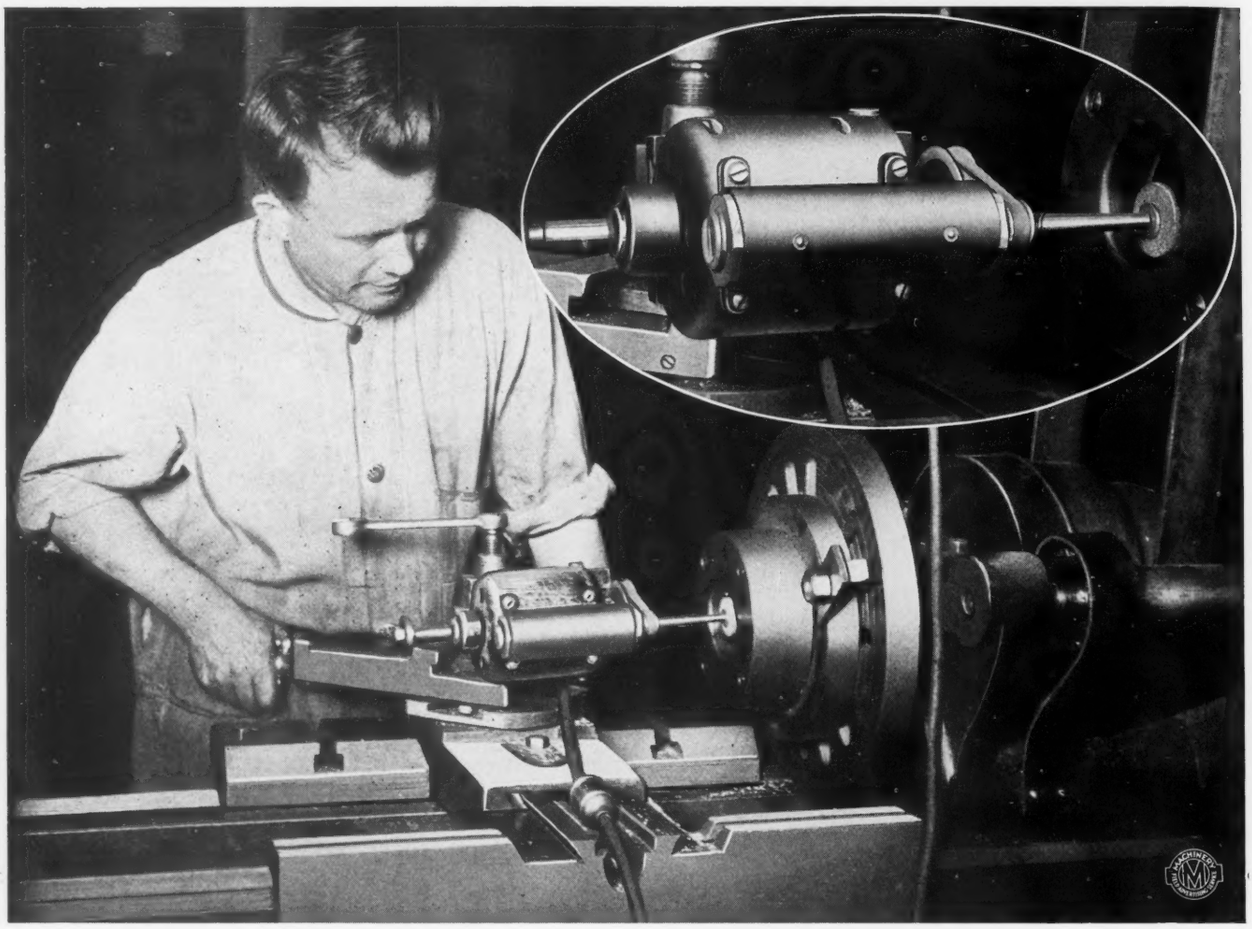
Above is a typical "Diamond" Surface Grinding job, handled with true "Diamond" efficiency throughout—bodies for high pressure oil pumps, rough and finish ground on both sides, 10 at a time, at the rate of 10 completed bodies in 90 minutes.

No gaskets are used in joining the bodies to the backs and the joint must withstand a pressure of 1000 lbs., so limits are necessarily very close—.015″ of metal being removed by the roughing cut and .0015″ in finishing. Material is gray cast iron and the pieces are 5½″ by 4″ overall.

The "Diamond" Line is complete: Surface Grinders in many styles and sizes, Face Grinding Machines—a complete range; Water Tool Grinders, Disc Grinders, Floor Grinders, Swing Frame Grinders and Polishing Machines—a machine for every grinding need. Catalog on request.

DIAMOND MACHINE COMPANY

PROVIDENCE, RHODE ISLAND



Increase Production—Lower Operating Costs

EQUIPPING the tool-room with one or more handy DUMORE High Speed Grinders means an increase of output and a lessening of costs on intricate grinding work. Because of their adaptability, these efficient grinders eliminate the need for costly tearing down of jobs and consequent wasteful delays.

Durably built in six useful styles and sizes, these compact high-speed grinders have long ago become indispensable in many varied industries. DUMORE grinders combine perfect running balance with correct cutting speed and work with a total lack of end play and absence of vibration—insuring speed and accuracy on the most delicate jobs.

Let the DUMORE solve *your* grinding problems. Ask your dealer about them or write us for descriptive literature and learn how DUMORE economy saves time and money. Write *today!*

The picture shows a DUMORE grinder in action at the plant of the Eric J. Strand Mfg. Co., Chicago. Accurately grinding interiors of deep dies, such as these, without removing them from the lathe — being used on the shapers to grind flat surfaces and on the milling machine for grinding contours and profiles is all in the day's work for this efficient tool. Surely, *you* have use for some one of the family of time-saving, profitable DUMORE grinders!

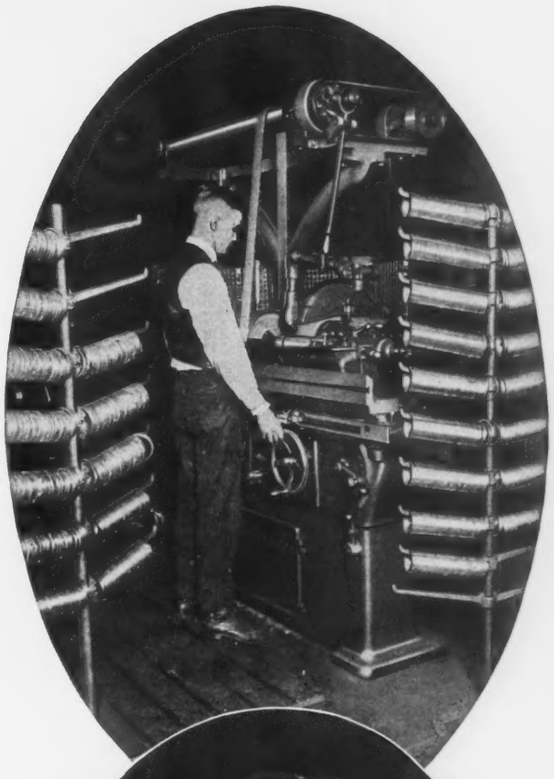
WISCONSIN ELECTRIC COMPANY

2550 Sixteenth Street **RACINE, WISCONSIN**

DUMORE HIGH SPEED GRINDERS

MODERN

Grinding Piston Rings is a Two Man Job Here; But They Find it Profitable, at That



At the Burd High Compression Ring Company's plant, Rockford, Ill., this Modern Grinder is used regularly 10 hours every day on the same job—rough and finish grinding 3″ by 3/16″ piston rings, *44 at a time.*

Speed is 126 ft. per minute; so fast, in fact, that it keeps one man busy loading and unloading duplicate arbors while another gives his entire attention to the machine.

The first operation removes 0.005″ of stock, and is performed at the rate of 3600 rings per day. Finish grinding reduces the diameter from 3.015″ to 2.995″ —allowing 0.001″ for heat expansion— and output is 3200 in the ten hours.

Modern Grinders have made similarly interesting records in many fields. Powerful, rigid, and smooth-running, they assure unfailing accuracy and a profitable output on any grinding operation within their broad and practical range.



Let us tell you about them.

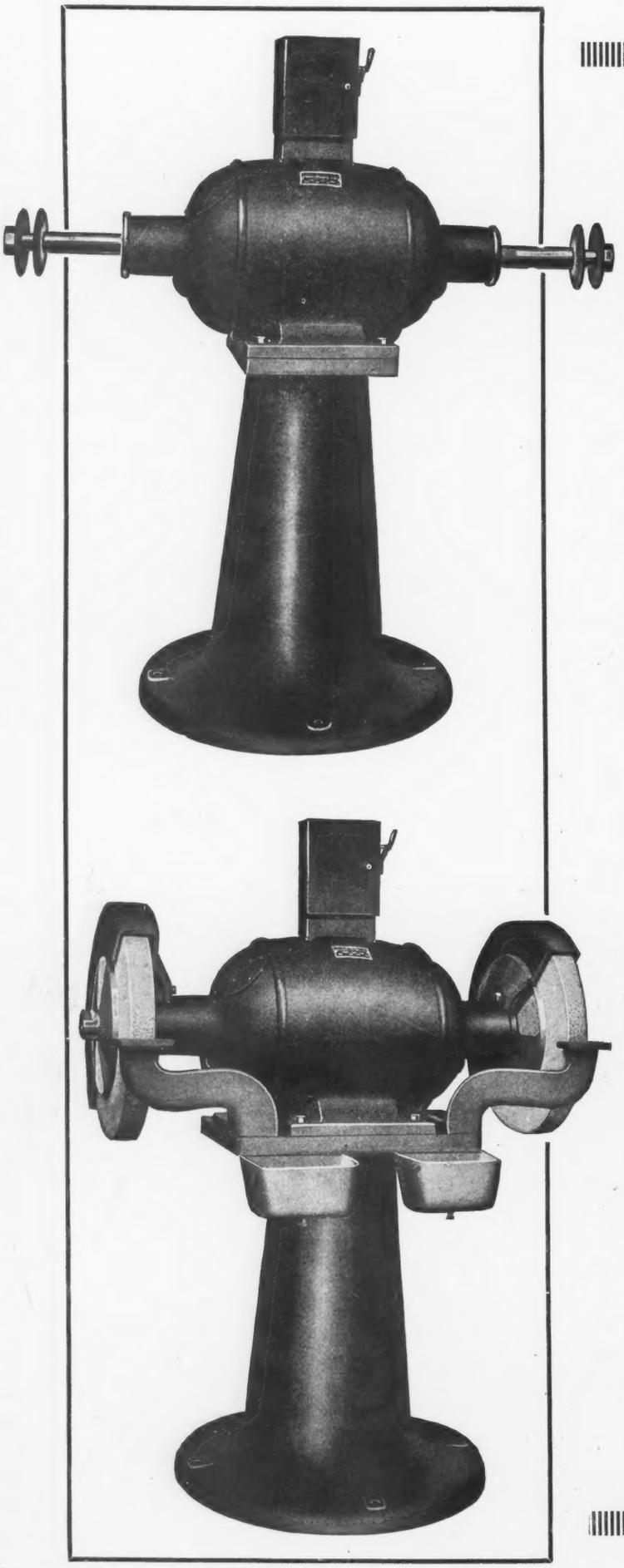
MODERN TOOL COMPANY

ERIE **PENNA., U. S. A.**

Main Office and Works: SECOND AND STATE STS.

Sales Agents in the United States: Walter H. Foster Co., 50 Church St., New York City, N. Y.; Sherritt & Stoer Company, 2006 Market St., Philadelphia, Pa.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Charles A. Strelinger Co., 149 Larned St., East, Detroit Mich.; E. L. Essley Machinery Co., 551-557 Washington Boulevard, Chicago—Branches, Milwaukee, Wis., Moline, Ill.; Manning, Maxwell & Moore, Inc., Railway Exchange Bldg., St. Louis, Mo.; Herberts Machinery & Supply Co., 401 East 3rd St., Los Angeles, Cal., and 140 First St., San Francisco, Cal.

Foreign Representatives: Leo C. Steinle, Inc., 1 Earl St., Westminster, London, S. W. 1, England; Glaenzer & Perreaud, 18 and 20 Faubourg du Temple, Paris, France; Rylander & Asplund, Stockholm, Sweden; C. Civita, Milan, Italy; The Yamatake Company, Tokyo, Japan; Rudel-Belnap Machinery Co., Ltd., 9 Wellington St., East Toronto, and 139 McGill St., Montreal, Canada.



Need a Buffer? Grinder?

Get the best the market affords. Note the simplicity of these heavy duty machines. The elimination of all unnecessary parts is one of the factors that make Dillon Grinders and Buffers so all around satisfactory.

All Dillon machines are ball bearing, self - contained, dustproof and practically noiseless. The cuts show the Dillon Heavy Duty Buffer and the Heavy Duty Grinder. Both of these machines are made with 3, 5, 7 1/2 H.P. motors; the same styles for medium duty are made in 1/2, 1, and 2 H.P. sizes. All machines are made for either alternating or direct current and may be had in bench or pedestal type as desired.

If you're interested in power saving grinding equipment—get the details of the Dillon Line.

THE DILLON ELECTRIC COMPANY

CANTON
OHIO, U. S. A.



William Sellers & Co., Incorp.

PHILADELPHIA, PA.

LABOR SAVING MACHINE TOOLS

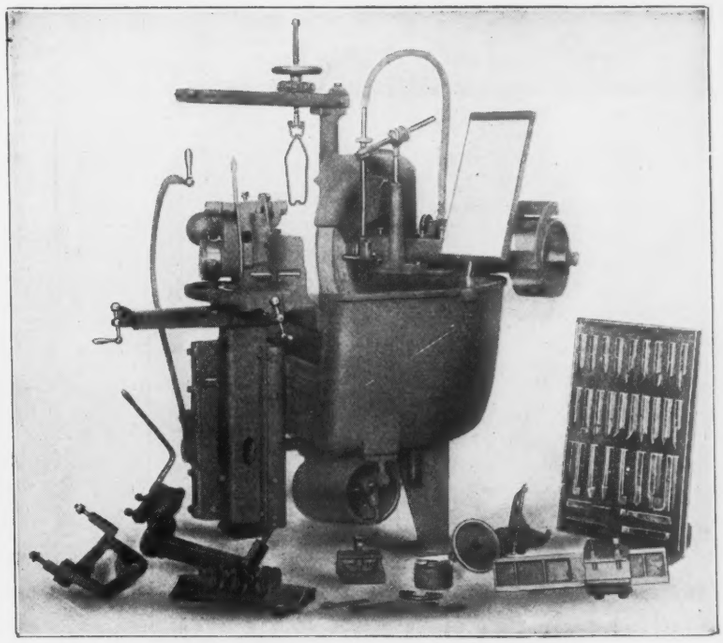
The Sellers Tool Grinder

for quickly, correctly and economically forming and sharpening cutting tools for Lathes, Planers, Slotters, etc., is without an equal. It produces and duplicates shapes and angles at a surprising saving over any other method.

Large Output
Accurate Work
Low Cost of Maintenance

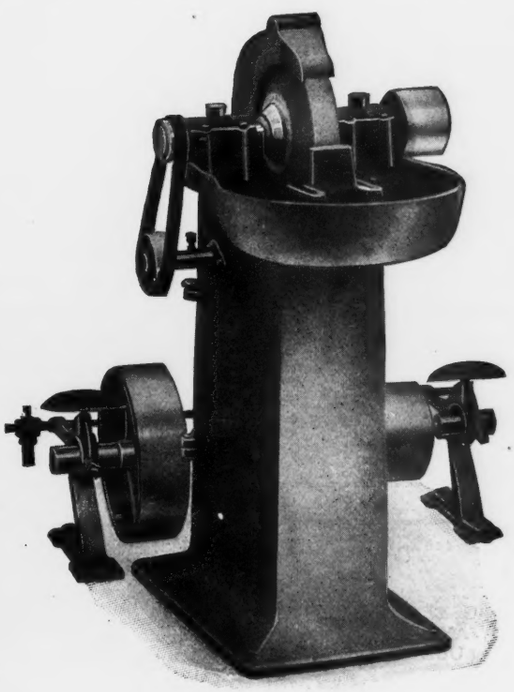
are three of the reasons why users of this machine find it so profitable that it is regarded as indispensable wherever installed. Tools ground and shaped by it do much more work before regrinding than when sharpened in any other way.

It Saves Time
It Saves Money



SHAFTING INJECTORS
DRILL GRINDING MACHINES

How and What Do You Grind?



"THE STERLING" PAT. APR. 10 1883 STERLING GRINDING WHEEL CO.

For every kind of grinding, from snagging to fine finishing, from quantity production to precision operation—anywhere in toolroom, factory or shop, there's a Sterling Grinding Wheel that is just right for the work. Sterling Grinding Machines will handle a variety of work efficiently. Let us tell you about them.

Send for the Sterling Catalog. Get a line on the service we can offer you in this efficient combination.

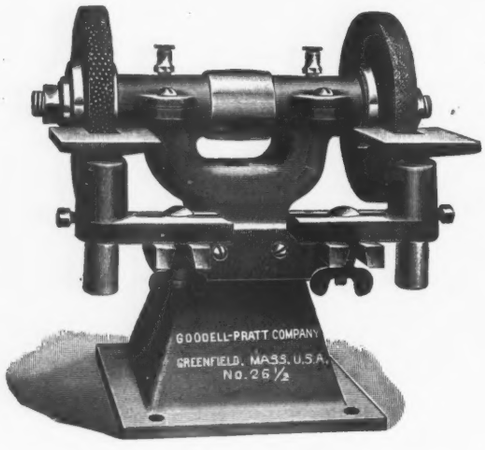
Sterling Grinding Wheel Co.

Factory and Offices: TIFFIN, OHIO

Distributors: L. BEST CO., 28-30 West Broadway, New York City
Chicago Store: 30 North Clinton Street

GOODELL-PRATT

1500 GOOD TOOLS



Polishing and Grinding Heads

Every shop, small or large, has use for little Polishing and Grinding Heads in many places. Our line of these useful little devices has so many different styles that every user can find one adapted to his needs.

The Frames are made of iron with hollow Bases so that they will be as light as possible. The Spindle Holes are reamed and counterbored. Both Spindles and Collars are lathe turned so that they will run accurately.

All sizes of these machines are provided with adjustable Boxes. The Pulleys will all take flat Belts, but the smaller sizes are grooved in order that round Belts may be used if desired.

A number of these Polishing Heads are provided with three jawed Chucks which greatly increase their field of usefulness.

All iron parts are finished in red and black enamel; steel parts are polished.

Full specifications of these Heads in our No. 14 Tool Book; complete copy of which we will be glad to send you upon request.

Goodell-Pratt Company

GREENFIELD *Toolsmiths* MASS., U. S. A.

An Economical General Purpose Grinder

A machine that's universally adjustable and equipped with a wide variety of attachments; that can swing a piece 9″ by 16″ if need be and provides 3 work speeds and 2 wheel speeds, instantly available.

Universal vise has three swivels; elevating and cross travel screws have micrometer dials and head swivels through 180°. Table surface is 4¼″ x 25″. Let us tell you the rest.

WOODS Universal Tool and Cutter Grinder

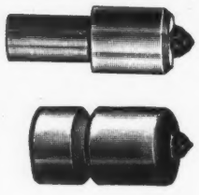
Made in Three Sizes



Woods Engineering Company

ALLIANCE OHIO, U. S. A.

FRANCIS DIAMOND GRINDER TOOLS



High Quality Stones Correctly Set

Diamonds are indispensable for truing fine grinding wheels; make sure you get the pick of the market by sending for an assortment of Francis Diamond Grinder Tools for selection.

Circular and Price List on Request

FRANCIS & CO., 50 State St., Hartford, Conn.

Established in 1799 First National Bank Bldg.

GRINDER

Knee Type Ring Wheel

For Flat Surfaces

THE GRAHAM MFG. CO., Providence, R. I.

The "Duplex" Emery Wheel Dresser

ONCE USED ALWAYS USED



CLEVELAND FLUE CLEANER MFG. CO.

524 Frankfort Ave., N. W. CLEVELAND, OHIO

A New Idea!

The Desmond Roller Bearing Dresser is the nearest perfect substitute for Diamonds ever devised. Our seventeen years experience in manufacturing Grinding Wheel Dressers and selling Diamonds should qualify us to speak with authority on this subject.

We will gladly send one on approval and you can judge for yourself.

The cutters are fastened on a bushing revolving on a roller bearing which in turn revolves on a pin ¾" diameter. Construction that not only practically eliminates wear on the bearings but greatly increases the life of the cutters. The bearings are dust-proof and easily oiled.

It is a member of our complete Dresser line consisting of

Diamonds **Desmond-Hex**
Diamo-Carbo **Desmond-Huntington. 3 sizes**
Magazine **Sherman**

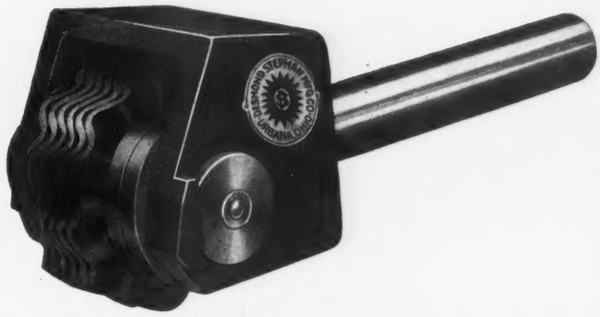
Price $12.50

Send for Circulars and More Details

The Desmond-Stephan Mfg. Company

URBANA, OHIO, U. S. A.

The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont., Canada. Alfred Herbert, Limited, Coventry, England.



DESMOND-STEPHAN ROLLER BEARING GRINDING WHEEL DRESSERS



Tire Rims

Are Successfully Ground on BRIDGEPORT SAFETY GRINDER No. 6 A. C. A.



Note long overhang of wheel

Investigate

The Bridgeport Safety Emery Wheel Co., Inc.
83 Knowlton Street, BRIDGEPORT, CONN.

THOMPSON

UNIVERSAL GRINDING MACHINES

SEND FOR BULLETIN No. U-13

THE THOMPSON GRINDER CO.
SPRINGFIELD - - - - - OHIO

HAND SNAGGING GRINDER

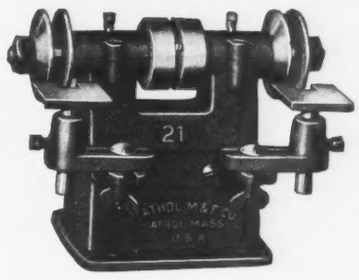
(Electric)



Light Weight, - - 20 pounds
Large Wheel, - - - - 7" x 2"
High Power, - - ¾ H. P. Max.

FORBES & MYERS, 178 Union St., Worcester, Mass.

Athol Bench Grinders



Practical machines for keeping reamers, counterbores, etc., in condition and for rough grinding small machine parts, castings and forgings.

No. 21 has adjustable rests—readily removed—and patent oil cups for bearings; takes 6" wheels, occupies 9⅝" by 5" of floor space and weighs 13 lbs.

New ATHOL Catalog No. 35 Describes the Whole Line.

Athol Machine & Foundry Co.

Athol, Mass., U. S. A.



Coats Emery Band Grinder

For producing a straight-line finish on all kinds of small metal parts and castings made of iron, steel, brass, gun-metal, also for grinding and polishing bone, fibre and horn goods, vulcanized rubber, celluloid, wood and similar materials.

COATS MACHINE TOOL COMPANY, Inc.
112 West 40th Street
New York

Grinding Wheels

DETROIT-STAR GRINDING WHEEL CO.

Are You Using the Right Abrasive?

Grain, grade, shape and size are not the only things to be considered in selecting grinding wheels. The type and quality of abrasive have equal if not greater effect on the cost and quality of output.

Steel and steel alloys require a sharp, friable abrasive; and our 50 years' experience has revealed nothing in this line as satisfactory as

"STARALOX"

Catalog Number 9 Explains



Detroit-Star Grinding Wheel Company
Established 1872
Detroit Michigan

Marschke Grinders and Buffers



"Economy" Buffers
Two Sizes—3 and 5 H. P.

The spindles of these machines are equipped with four sets of S K F Ball Bearings — motor bearings being entirely independent of outboard bearings. Arbors are 48 inches to take 1 or 1¼ inch wheels; wheels are 40 inches apart and the bases occupy 20 by 23 inches of floor space.

Foot Lever Starter Saves Time and Power



The No. 12 Grinder
Two Styles—A. C. and D. C.

The hoods on this machine are equipped to adjust themselves automatically when the steady-rest is adjusted to the wear of the wheel. Exhaust fan is equipped with S K F Ball Bearings, is belted direct to the motor and starts automatically with it. Foot pedal starter takes 4 seconds to start motor—stops instantly.

More Details on Request

Marschke Manufacturing Co.
Indianapolis, Indiana
U. S. A.

R.V TOOL POST STYLE GRINDERS



A powerful and efficient portable grinding outfit for sharpening dies, milling cutters, etc., without removing them from the machine and for internal and external grinding, retouching, trueing, etc.

Ball bearing spindles, 1 H.P. Motor, compact carrying case and complete assortment of wheels. Use it anywhere.

Weight 22 lbs. Speed 4,000 to 12,000 R. P. M.

Information on request.

ARVA STROUD 327 BROADWAY NEW YORK CITY

Emery Wheel Dressers

Two Sizes Nos. 1-2

CUTTERS

We make the regular Huntington (Pattern) for all sizes.
Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEO. H. CALDER CO., Lancaster, Pa., U. S. A.

BADGER TOOL COMPANY

Grinding Machinery
Supplies and Accessories

E. B. GARDNER, President R. D. GARDNER, Treasurer
BELOIT, WISCONSIN, U. S. A.

VITRIFIED



Rapid, cool cutting, non-glazing grinding wheels made in grades, grains, shapes and sizes to handle all classes of work. Get the right one—our experts will help you select it—and be sure of permanently satisfactory service on the work for which it was chosen.

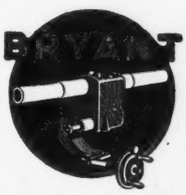
Send for a Vitrified Catalog. Get Acquainted with Vitrified Service.

VITRIFIED WHEEL COMPANY, Westfield, Mass., U. S. A.

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT

Builders of



Hole Grinders
Hole and Face Grinders
Deep Hole Grinders

Reg. U. S. Pat. Off.

When You Think of a Disc Grinder, Think of a

GARDNER

Gardner Machine Co., Beloit, Wis., U.S.A.



GRINDING WHEELS

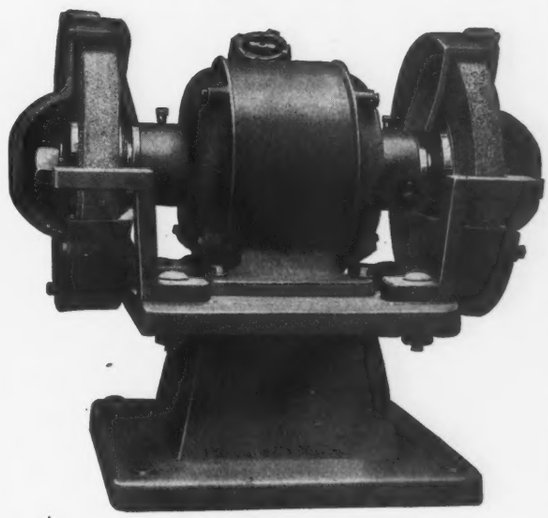
FOR ALL PURPOSES

Steel and Hard Metals
Cast Iron and Soft Metals

THE CLEVELAND ABRASIVE WHEEL CO.
2629 East 25th Street Cleveland, O., U. S. A.

BLOUNT

Ball-Bearing Motor Grinders
BENCH TYPE



With SAFETY enclosed guards

Built in 5 Sizes—½ to 3 H.P.

J. G. BLOUNT COMPANY
EVERETT, MASS.

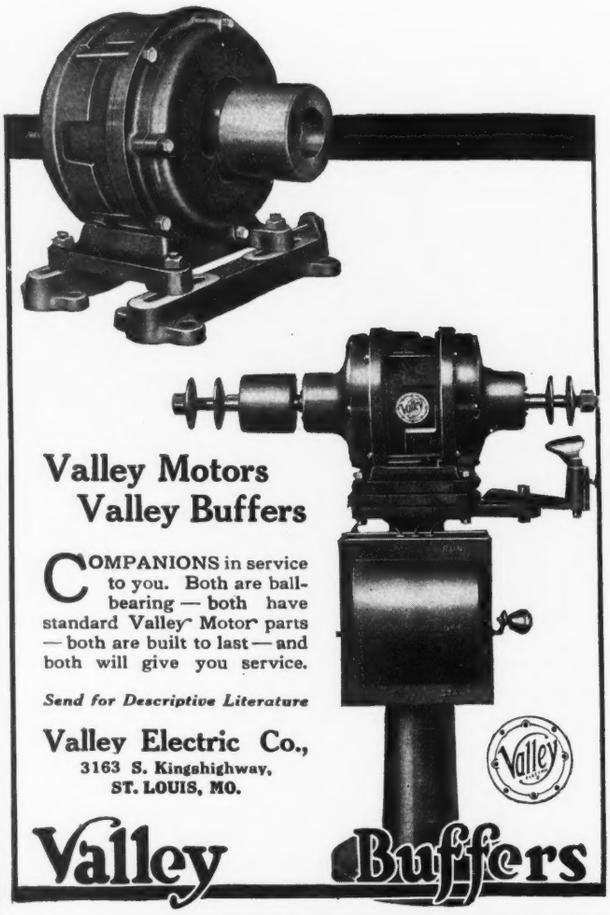
RANSOM
GRINDING MACHINES



The chances are more than even that you need one or more of these 12 in. x 1 in. Grinders in your plant. Get the best. Investigate this No. 109 with the pedal starter and automatic stop, ball bearings and ¾ H.P. G. E. Motor.

Ask for Bulletin K2

Ransom Manufacturing Co.
OSHKOSH WIS., U. S. A.



Valley Motors
Valley Buffers

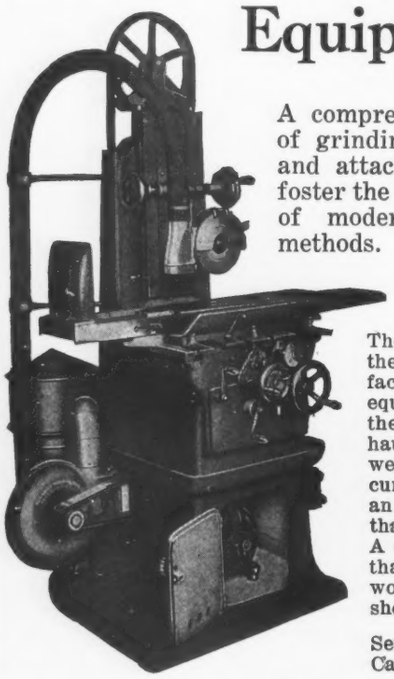
COMPANIONS in service to you. Both are ball-bearing — both have standard Valley Motor parts — both are built to last — and both will give you service.

Send for Descriptive Literature

Valley Electric Co.,
3163 S. Kingshighway,
ST. LOUIS, MO.

Valley Buffers

Abrasive Grinding Equipment

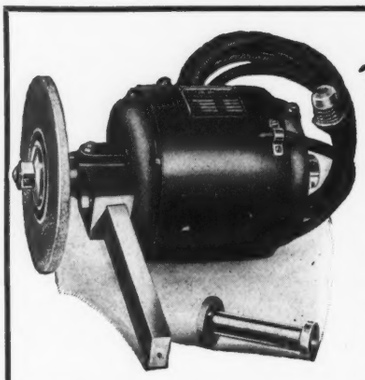


A comprehensive line of grinding machines and attachments that foster the development of modern grinding methods.

The cut shows the Abrasive Surface Grinder, equipped with the Abrasive Exhaust Unit. A well balanced, accurate machine; an exhaust unit that **gets the dirt.** A combination that means clean work in a clean shop.

Send for the Catalog.

Abrasive Machine Tool Co.
E. Providence R. I., U. S. A.



STOW Tool Post Grinder

For grinding Centers, Dies, Cutters and other equipment, this grinder is in a class of its own. Handles both Internal and Surface Grinding—hand feed or plain feed. Regular equipment ⅜"x6" wheel, internal grinding attachment, with 10 ft. flexible cord and plug to fit standard lamp socket. Write for details.

STOW MANUFACTURING CO., Inc., Binghamton, N. Y.
London Stock: 85 Queen Victoria Street

Strand
TRADE MARK



POWER NUT SETTING WITH A

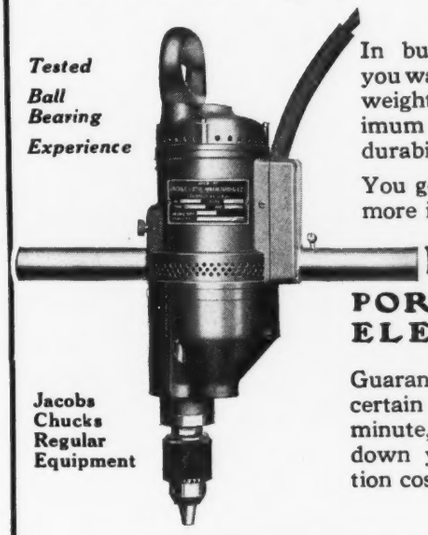
STRAND

Made in several sizes. Write us.

N. A. STRAND & CO.
CHICAGO
Manufacturers Flexible Shafts and Equipments
625 W. Jackson Blvd.

Light in Weight But Heavy in Power

Tested Ball Bearing Experience



In buying a drill you want minimum weight with maximum power and durability.

You get all that and more in the

PIONEER PORTABLE ELECTRIC

Guaranteed to drill certain depth per minute, thus cutting down your production cost.

Jacobs Chucks Regular Equipment

BUY THE PIONEER

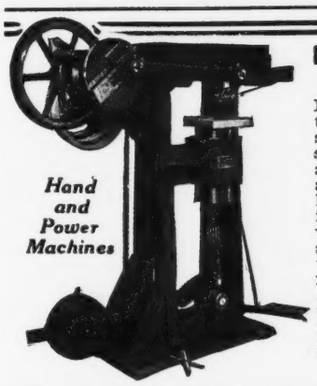
"It Will Do the Work"

Louisville Electric Mfg. Co.

INCORPORATED

C. E. WILLEY, President J. B. McFERRAN, Sec'y-Treas.

LOUISVILLE, KENTUCKY, U. S. A.



Hand and Power Machines

Noble & Westbrook Marking Machines

Mark in an artistic manner articles of nearly any shape or size that will take an impression from a steel stamp. Taps and Twist Drills can be marked at the rate of 700 to 1000 per hour. These machines are flexible enough to mark parts that vary in thickness up to 1/16 of an inch. This feature combined with the rolling method of marking relieves the steel stamps of that strain which is not provided for in other methods of marking. We also make

Stamps for Every Marking Purpose

The Noble & Westbrook Mfg. Co., Hartford, Conn.

"Improved Marking Devices"

Broaching Machines and Broaches

Our **years** of **experience** in the successful manufacture of broaching equipment assures you of the most **up-to-date** and **progressive** methods.

May we not quote? Write for catalog

J. N. LAPOINTE CO. of New London, Conn.

PORTABLE ELECTRIC DRILLS and GRINDERS

Complete line of sizes suitable for DC-AC and Universal Current

Tested to U. S. Navy requirements



Type L2U-¼" Universal Catalog No. 9

THE NEIL & SMITH ELECTRIC TOOL CO. **Cincinnati Ohio**



CLARK AUTOMATIC DRILL

On a great many ships of the U. S. Navy, as well as in ship yards, CLARK DRILLS are regular equipment, because they give heavy-duty service with absolute precision.

The New CLARK AUTOMATIC DRILL will give you the same endurance and accuracy in hard continuous use, with the addition of light weight.

Wherever there is an electric socket—direct or alternating current—CLARK AUTOMATIC DRILL is ready for instant use, even in the closest places.

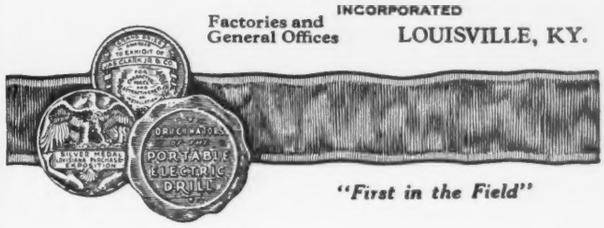
CLARK "BLUE RIBBON" ELECTRICAL EQUIPMENT is designed by the originator of portable electric drills to reduce production costs.

Write for catalog of CLARK EQUIPMENT—a complete line of motors, dynamos and drills, buffers, grinders—both portable and bench type—with built-in motors.

Jas. Clark, Jr. Electric Co.

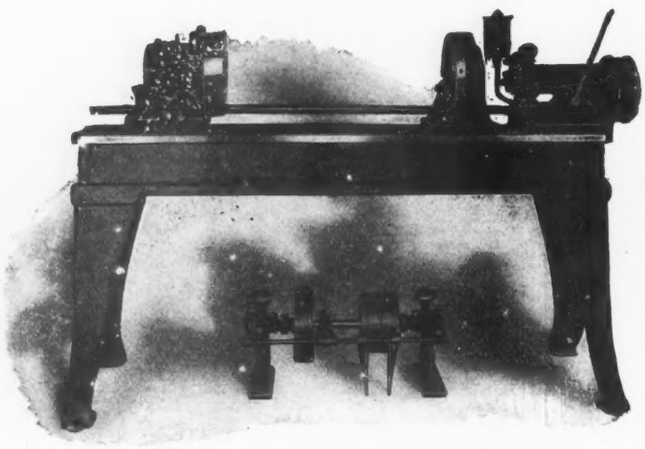
INCORPORATED

Factories and General Offices LOUISVILLE, KY.



"First in the Field"

THE WHITON
Revolving Centering Machine



For Accurately Centering Finished Shafts

The cut shows new *Revolving Centering Machine* — a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machines and embodies all the special features.

Circulars and prices sent upon application.

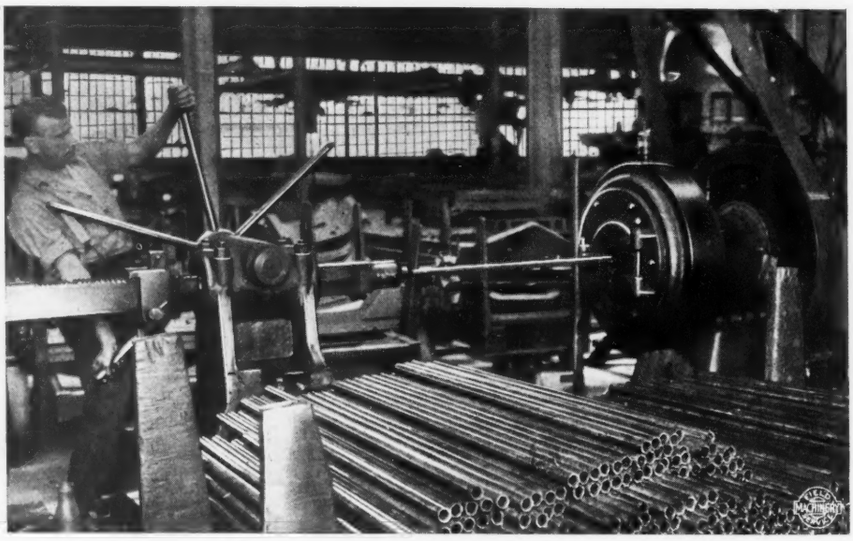
THE D. E. WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT, U. S. A.

FOUR ETNA SWAGERS

In the A. O. Smith Plant

The A. O. Smith Company, of Milwaukee, makes automobile chassis. Entering into the frame construction are the tie rods made of steel tubing about 1⅛" diameter.

To facilitate correct assembly these rods must have ends of accurate diameter, and to insure this perfection, the Smith people use four Etna Swagers.

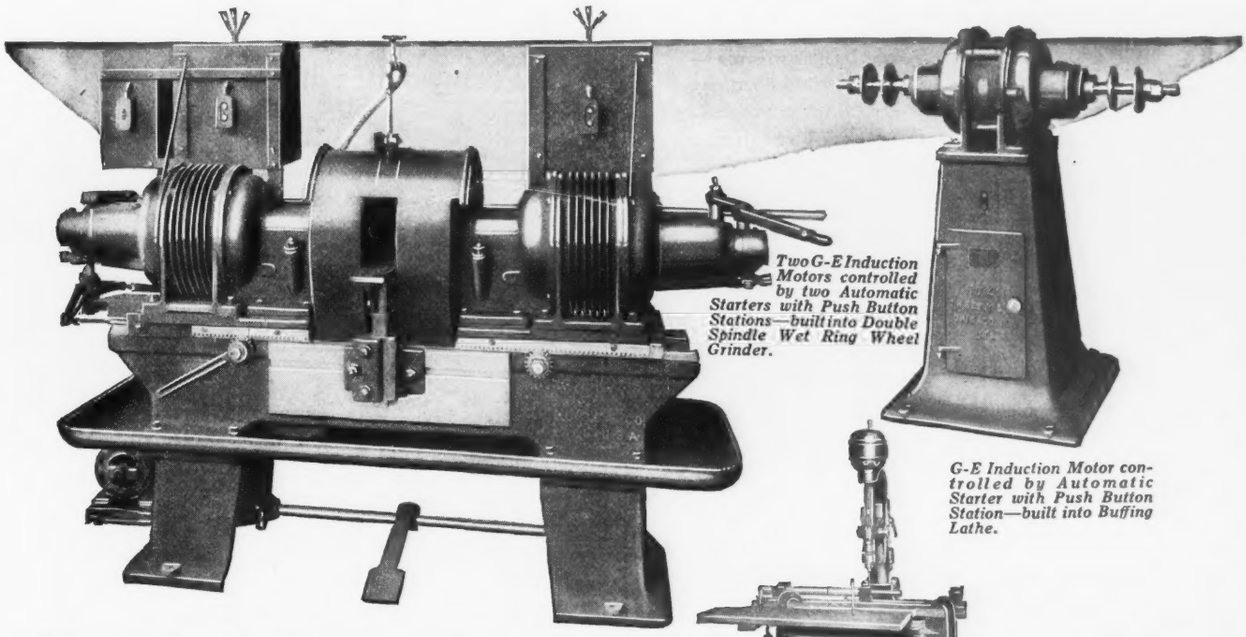


As the tubing comes from the mill oversize in varying degrees—never uniform—swaging was decided upon to insure positive uniformity. Etna gives perfect, low cost results. Production: 200 tubes per machine per hour. The photograph shows operator working capstan wheel, forcing tube into rotating dies of the swager.

Let us tell you all about swaging.

THE ETNA MACHINE COMPANY
Maplewood Ave. and Castle Blvd. **TOLEDO, OHIO**

Modern Industry has no place for the old, inefficient methods of power transmission with their high power losses and frequent service interruptions



Two G-E Induction Motors controlled by two Automatic Starters with Push Button Stations—built into Double Spindle Wet Ring Wheel Grinder.

G-E Induction Motor controlled by Automatic Starter with Push Button Station—built into Buffing Lathe.

Now it's the "built-in" motor

Applying power to machine tools has been a hard problem. Shafting and belts were wasteful. Direct-drive was better, but today highest efficiency is obtained by the use of G-E High Speed Induction Motors built into machine tools. G-E engineers have developed these motors to work at speeds heretofore commercially impractical.

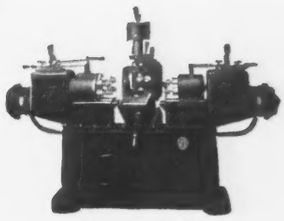
G-E "built-in" motors are supplied for operations up to and including 3600 r.p.m. on 60-cycle circuits. If higher speeds are required, induction frequency changers are included—which step up the frequency above 60-cycles, and so obtain higher speeds on these motors.

Many foremost makers of metal-working machine tools use these motors. In place of one attached motor on a certain type of Tapping Machine for instance, greatest economy is gained by building three into the machine.

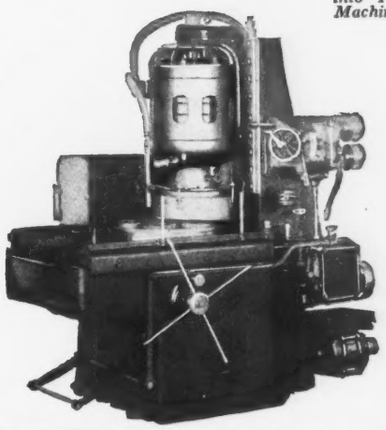
Wherever these G-E "built-in" High Speed Motors are used—production goes up, floor space is saved, and light is less obstructed. Practically every industry finds these motors money savers. Hand or magnetic control apparatus is furnished for machines equipped with them.

Bulletin 41521A contains all the facts. Send for it.

G-E two-speed Induction Motor driving direct on spindle of High Speed Drill—drilling speeds are 10,800 r.p.m. and 5,400 r.p.m.



Three G-E Motors built into Tapping Machine.



G-E Induction Motor built into the head of a Surface Grinder.

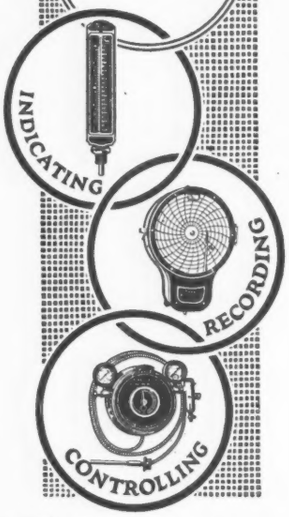
General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

43B-650

Tycos Temperature Instruments



OPERATIVES

appreciate the assistance of *Tycos* temperature instruments—indicating, recording, controlling—in the attainment of a high rate of personal efficiency.

Catalogue upon request. Give firm connection if you please.



Taylor Instrument Companies

Rochester, N.Y., U.S.A.

Theres a *Tycos* and *Taylor* temperature instrument for every purpose 825



Performance has two dimensions—Quality and Quantity

We could tell you of the endless research in both field and laboratory that has developed such improvements as Automatic Temperature Control. We could point with pride to equipment that winds moving elements with wire as fine as a hair—or to the 101 other differences in Brown methods that are responsible for Brown accuracy and stamina.

But it's what Brown instruments do in the field, in every-day, hard service that counts.

In the field Browns are supreme. There are nearly as many Brown Pyrometers in use in America as all other makes combined—because they make good, and keep right on making good, without coaxing

The Brown Instrument Co.

4510 Wayne Avenue Philadelphia, Pa.

New York Pittsburgh Cleveland Detroit Chicago St. Louis Denver Los Angeles San Francisco Montreal

Brown Pyrometers

Most used in the world

The Luma Combination for Demagnetizing, Etching, Annealing and Soldering

Complete, compact and self-contained—takes current from any A. C. lighting circuit.

A quick demagnetizer, a handy etching pencil, a practical device for annealing and soldering.

Substantial, convenient and profitable—there's a place for it in every shop.

May we send you further details?



LUMA ELECTRIC EQUIPMENT CO.

407 Spitzer Building TOLEDO, OHIO

SHEET METAL



Barrels, tanks, cooking utensils, enameled ware, cans, pails, containers of all kinds, cabinets, doors, etc., are being seam welded, pressure tight at the rate of

150 FEET PER HOUR

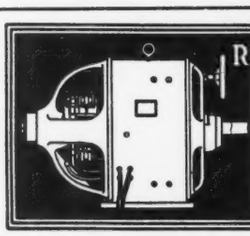
Can your process compete with this?

Write for details and samples.

Gibb Instrument Company

Manufacturers and Importers of WELDING MACHINES

General Motors Bldg., Detroit, Mich.



RELIANCE MOTORS

Type AS Reliance Motors run at any speed over any range up to 1 to 10. No electric controller is needed

RELIANCE ELECTRIC & ENGINEERING CO.
1056 Ivanhoe Road Cleveland, Ohio

KASENIT

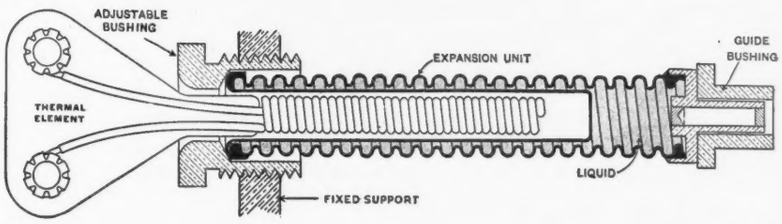
Non-poisonous — Non-Explosive — Non-Inflammable

Open Fire Case Hardening Compound

KASENIT CO., Div. 3, 30 So. William St., New York

Monitor Thermaload Starter

Patents Issued and Pending



Expansion Unit of the Monitor Thermaload Starter

THIS unit, with the exception of the thermal element, is identical in all Thermaload starters. The thermal elements are all interchangeable and are chosen to suit the full-load rating of the starter.

In service, the slight heat produced by the motor current through the element expands the liquid in the double-wall container, imparting a longitudinal travel to the free end of the unit, which is permitted by the corrugated construction of the outer wall.

This unit is remarkable for its efficiency, requiring only 2.14 watts at full-load. Consequently, the resistance of the elements is so small that there is no appreciable drop in motor voltage.

The rating of any given starter can be changed instantly by inserting the proper size thermal element. No change in adjustment is necessary when changing from one size element to another.

Thermaload starters are furnished for either momentary contact or maintained contact pilot control.

Monitor Controller Company

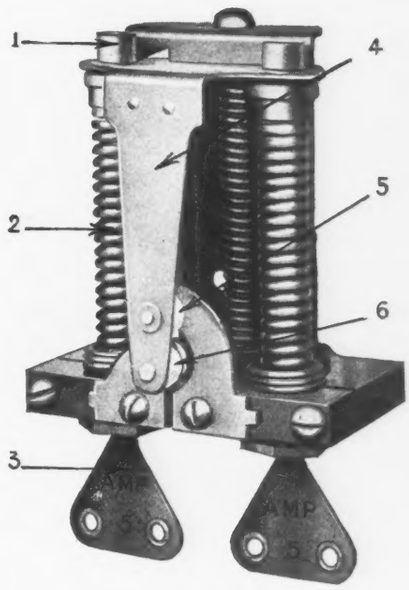
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Cleveland

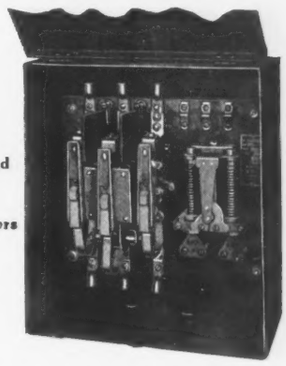
The Original "Just Press a Button" System

Chicago
Boston
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Pittsburgh
Detroit

2081



1. Lava guide bushing.
2. Powerful expansion unit.
3. Thermal unit, which is the same for all ratings, varying only in resistance.
4. Flutter-proof contact, which may be arranged for any desired delay of resetting.
5. Pick-up contact.
6. Relay contact arm and yoke, which transmits and multiplies the motion of the expanding units.



Monitor Thermaload Starter for A C. Motors

Our book, "Starters for Small A. C. Motors," gives a complete description of the new Monitor Thermal Relay and the Thermaload Starter. **Use coupon below and get a free copy.**

Monitor Controller Company, Baltimore

Send me a free copy of "Starters for Small A. C. Motors No. 1016."

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State.....

THE COLBURN MACHINE TOOL CO.

1038 Ivanhoe Road, Cleveland, Ohio

Builders of
Heavy Duty Boring and Turning Mills and
Heavy Duty Drill Presses.

BENCH MILLING MACHINE



For Small Work in Large Quantities

This machine is built with the same care as our larger millers; it is accurate and right in every particular; highly profitable on a wide variety of small work. Can be had with floor column if desired. Ask for complete description.

THE CARTER & HAKES COMPANY
Sterling Place **WINSTED, CONN.**

BRIGGS MILLERS

Rugged arch support; many speeds and feeds controlled by powerful gears; and a long, well-supported table.

You ought to see these machines eat up the work—finishing die blocks, keyseating crankshafts, surfacing cylinder heads, etc. Let us tell you more about them.

GOOLEY & EDLUND, Inc.
CORTLAND, N. Y., U. S. A.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U.S.A.

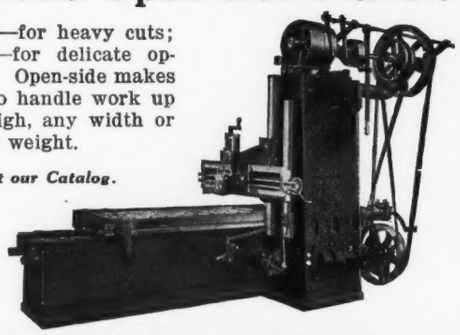
Paris, Turin, Zurich, Barcelona, Petrograd

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Cleveland Open-Side Planers

Powerful—for heavy cuts; accurate—for delicate operations. Open-side makes it easy to handle work up to 72" high, any width or length or weight.

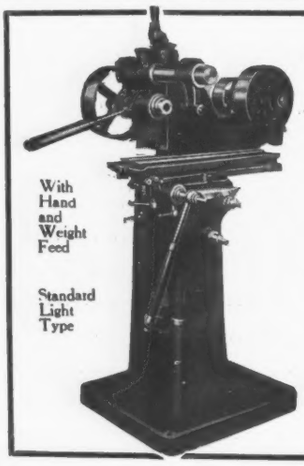
Get our Catalog.



Established 1900

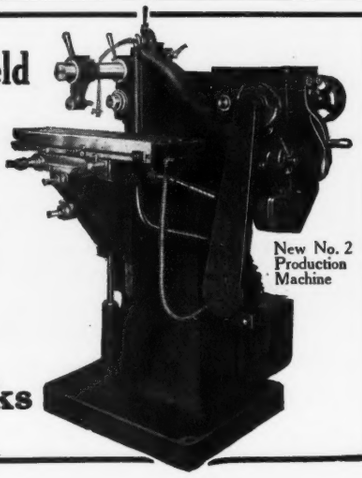
The Cleveland Planer Co. **3152 Superior Avenue CLEVELAND, OHIO, U. S. A.**

"Standard" Millers Have a Big Field



Various forms of equipment are available by which these convenient Plain Hand and Weight Fed Milling Machines can be readily converted into either Universal or Spline Milling Machines. Power Table Feed is also available for the larger sizes, as well as Vises, Arbors, Collets, etc., to permit them to handle any work within their range—toolroom, experimental work, odd lot milling or duplicate part work too small to handle economically on the big machines.

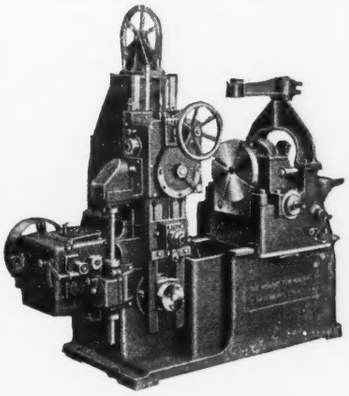
Prices range from $300 to $700, according to size and equipment. Let us tell you more about them



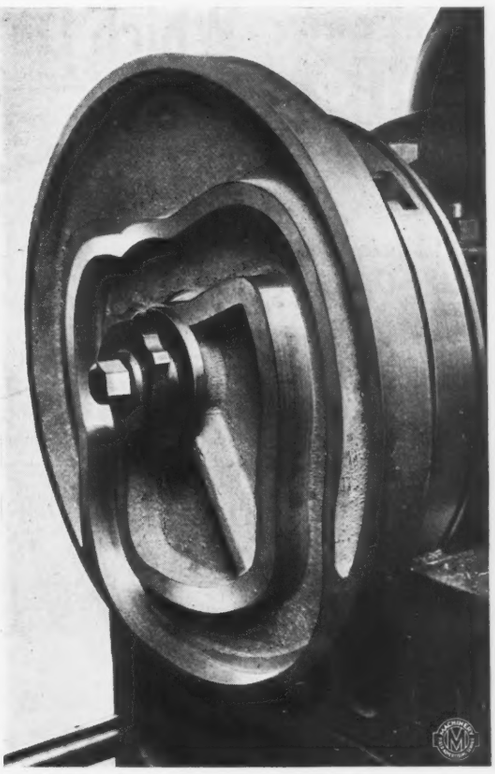
Standard Engineering Works
Pawtucket, Rhode Island

Rowbottom for Cams

This is a Rowbottom Cam cut on a Rowbottom Cam Milling Machine in the Rowbottom Contract Shop. The cam is 17″ outside diameter; the cam path 1.750″ wide, 57/64″ deep, groove cored in casting with about 1/8″ of metal left to be removed, is completed in two cuts —one roughing, one finishing—time 40 minutes floor to floor.

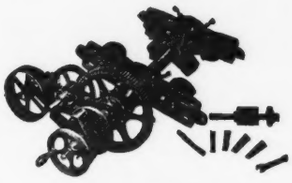


Let us estimate on your cams; or, if you cut them in your plant get the details of Rowbottom Cam Milling Machines



The Rowbottom Machine Company WATERBURY, CONNECTICUT
Factory, Waterville, Conn.

Underwood Portable Tools



Engine Repairs

for Industrial Plants, Railroad Shops, Ship Yards and General Repair Shops.

Portable Boring Bars, Crank Pin Turning Machines, Rotary Planers, Milling Machines, Pipe Benders, Cylinder or Dome Facers.

Write for Complete Catalogue

H. B. UNDERWOOD CORPORATION
PHILADELPHIA (Est. 1870) PENNA., U. S. A.

They-do-the most. HEAT They-wear-the longest.
SNELLEX AUTOMATIC CENTERS
Contract with expansion of work, and revolve on ball-bearings.
Ask for Circular. –Snellex Mfg. Co.– Rochester, N. Y.

Planers **"OHIO"** Shapers

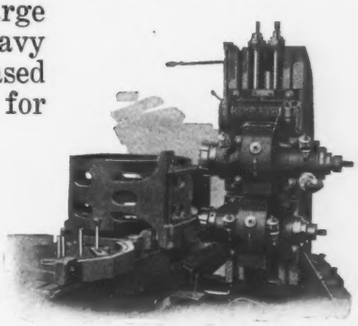
Full particulars from address below or nearest agent

OHIO MACHINE TOOL CO., Kenton, O.
Established in 1887

KEMPSMITH

The No. 33 Two-spindle Production Miller

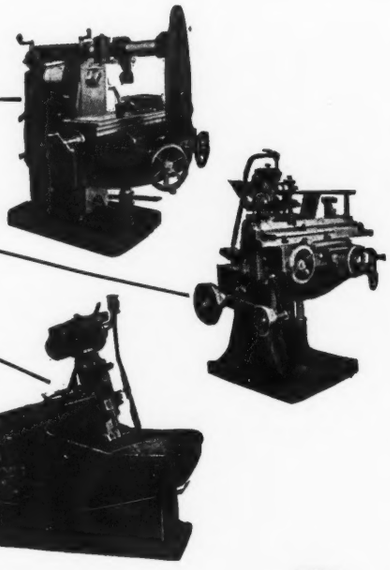
Combining high speeds, strength and accuracy, the Kempsmith No. 33 2-Spindle Miller is a revelation the first time you see it perform. It cuts costs and keeps down non-productive time. In the picture Kempsmith is shown milling motor frames. By using the double spindle, two small diameter facing cutters are used instead of one large one. Result: heavy feed and increased speed. Write for details.



KEMPSMITH MFG. CO.
MILWAUKEE, U. S. A.

MILLERS
OHIO
GRINDERS

Which Do You Need?



"Tools in Which Every Ounce Works"

The "Ohio" group forms a complete Milling department in itself. Ohio Plain and Universal Milling Machines, endorsed by years of satisfactory performances in many well known toolrooms and shops; Ohio Tool and Cutter Grinders stimulate output generally by keeping all the tools in the shop in condition and handle odd jobs of cylindrical precision grinding on the side; and the Ohio Tilted Rotary which has effected such sweeping reductions in the cost of production milling that it is rated indispensable in railway shops, automobile factories, machine shops and other places using large quantities of duplicate parts.

Without doubt you'll find the solution of your milling problem in one of these machines.

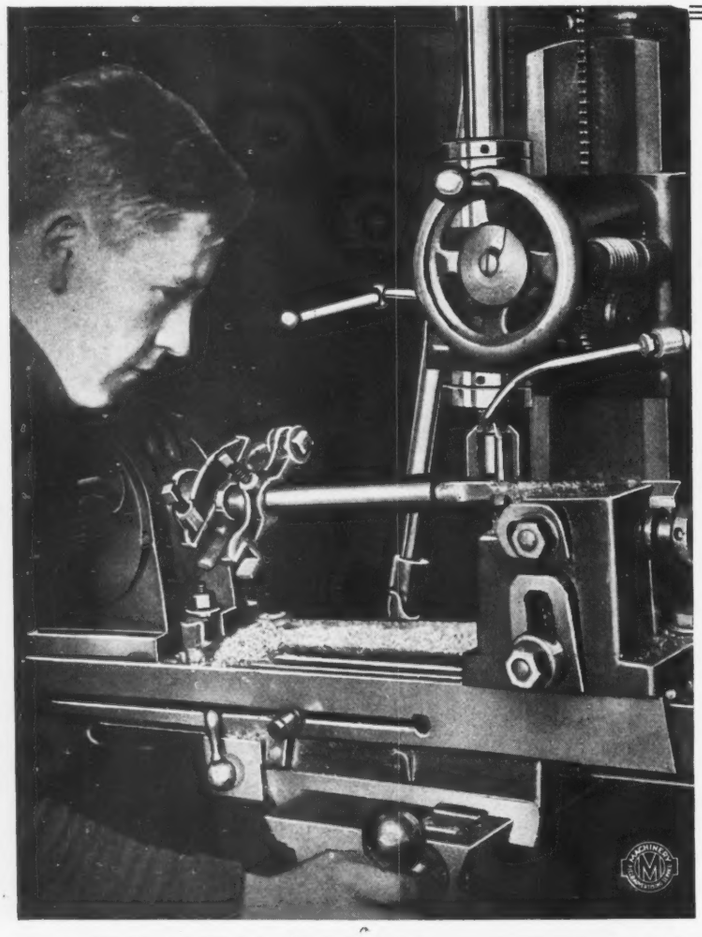
The Oesterlein Machine Company
CINCINNATI, OHIO, U. S. A.

O. S. Terlein Says—

Bulletin "B" outlines the activities of the Tilted Rotary and explains how our service department helps manufacturers who avail themselves of its almost unlimited field of usefulness.

Write for your copy today





Tool Work on Production Basis

Nearly everybody familiar with machine tools knows about the Knight Miller's adaptability for precision work. But here is something unusual. The picture shows the Knight doing tool work on a *manufacturing basis*. The photograph is shown through courtesy of the McCrosky Tool Corporation at Meadville, Pa.

The work in progress is milling a "square" on a chrome nickel steel arbor for an "Ideal" reamer. The "square" measures 23/64" one way and .447" the other at the small end. It tapers, gradually reducing from the full ¾" diameter of the piece. The table is swung 8 degrees from the horizontal in order to produce the proper taper.

Let us tell you more about Knight Milling and Drilling Machines and what they can do

W. B. KNIGHT MACHINERY CO.
3920 West Pine St. ST. LOUIS, MO.

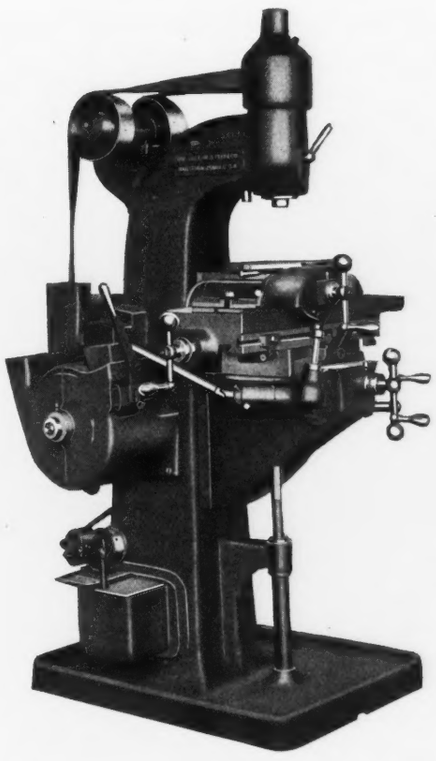
AGENTS: Coats Machine Tool Co., Ltd., London, England. Eccles & Smith Co., San Francisco, Pacific Coast. Lynd-Farquhar Company, Boston, Mass. Manning, Maxwell & Moore, Inc., New York, Chicago, Philadelphia, Buffalo, Milwaukee and New Haven. Somers, Fitler & Todd Co., Pittsburgh, Pa. Strong, Carlisle & Hammond Co., Cleveland and Detroit. Vonnegut Machinery Co., Indianapolis, Ind. Allied Machinery Company of America, France, Spain, Portugal, Italy, Switzerland, Norway, Sweden, Denmark, and Belgium. Yamatake Company, Japan.

The Taylor & Fenn Vertical Milling Machine

Just the Right Speed!

Speed is an important factor in really efficient light milling. This machine has thirty-eight spindle speeds—from 500 to 3100 R. P. M. in small steps—and thirty-three power feeds. The unusually large number of combinations which can be obtained by the use of change gears makes it possible to operate H. S. steel cutters of one inch or less at precisely the speed at which they will be most efficient.

For economy in light milling *get the right machine.* Send for the circular of this one today.



The Taylor & Fenn Company

HARTFORD, CONN., U. S. A.

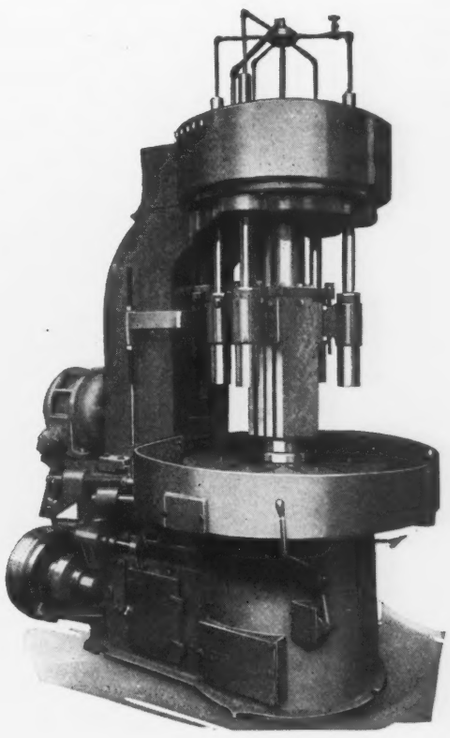
The Daniels Automatic

For definite records we can refer you to the reports of satisfied users; for an idea of prospective profits on your work we will give you time study estimates on your blueprints or samples that will be an interesting basis for comparison with your present figures.

It stands to reason that a machine which does the work of five machines and requires only a single operator will make an amazing difference in the cost of manufacturing anything within its range.

Capacity for cup turning, boring, reaming, facing, tapping with collapsible or solid taps or drilling multiple spindle off-set holes on work from 3″ to 7″ in diameter.

Send for a circular of "The Machine That Does Everything but Think."



McDonough Mfg. Company

EAU CLAIRE WISCONSIN, U. S. A.

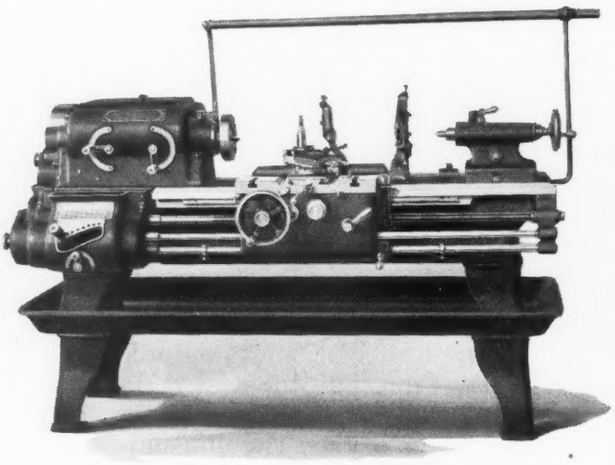
"SUNDSTRAND" 14-Inch Tool Room Lathes

Meet Every Modern Tool Room Need

Designed to secure more and better work with less effort and at lower cost; to assure accuracy; to handle a wide variety of work.

These machines combine all the best features of modern tool room lathe design with certain exclusive advantages which owners and operators alike are quick to appreciate. They make unusual records for convenience, quality and cost of service wherever they are installed.

Let us tell you more about them.

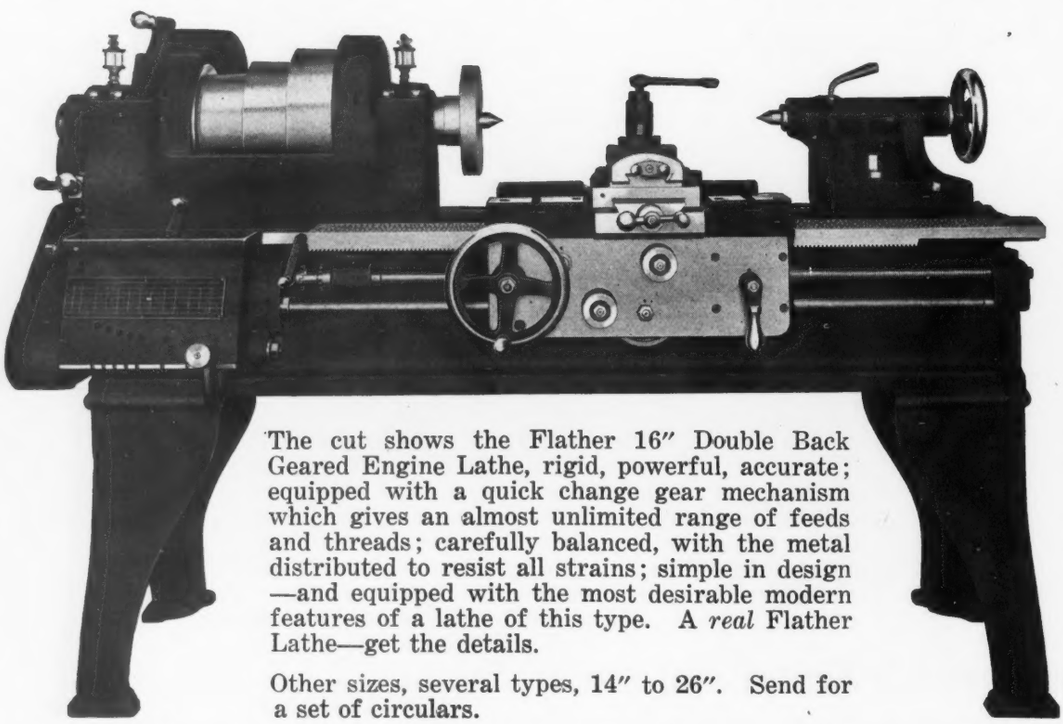


Specifications include 12 spindle speeds; 48 changes of feed and thread—1½ to 92 threads including 11½; feeds of 6 to 368 per inch; 15" swing, etc.

ROCKFORD TOOL CO., 2400 Eleventh Street, Rockford, Ill.

Aumen Machinery Co., 107 E. Lombard St., Baltimore, Md.; Cadillac Machinery Co., Beaubien and Lafayette Sts., Detroit, Mich.; Dale Machinery Co., Inc., 541-7 Washington Blvd., Chicago, Ill.; Dale Machinery Co., Inc., 17 East 42nd St., New York City; E. A. Eddy Machinery Co., Eddy and Clifford Sts., Providence, R. I.; Herberts Machinery & Supply Co., 3rd and San Pedro Sts., Los Angeles, Calif.; Herberts Machinery & Supply Co., 140 First St., San Francisco, Calif.; Hess-Schenck Co., Cleveland, Ohio; William C. Johnson & Sons Machine Co., 1001 North Sixth St., St. Louis, Mo.; M. D. Larkin Supply Co., 501-503 East Third St., Dayton, Ohio; Mid-West Machinery Exchange, 1314 East 15th St., Kansas City, Mo.; McMullen Machinery Co., 64-66 Ionia Ave., S. W., Grand Rapids, Mich.; Mid-West Machine Tool & Supply Co., 321 East Fourth St., Davenport, Iowa; F. E. Satterlee Co., 118 Washington Ave., N., Minneapolis, Minn.; William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa.; Homer Strong & Co., Inc., 301 State St., Rochester, N. Y.; Homer Strong & Co., Inc., University Bldg., Syracuse, N. Y.; Sales Limited, 313 Duncan Bldg., Vancouver, B. C.; Swind Machinery Co., Widener Bldg., Philadelphia, Pa.; Charles A. Strelinger Co., Ltd., Windsor, Ont.

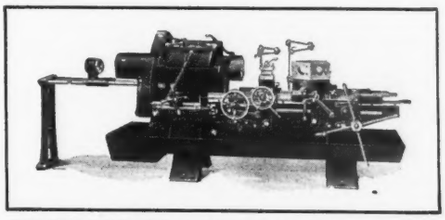
FLATHER LATHES



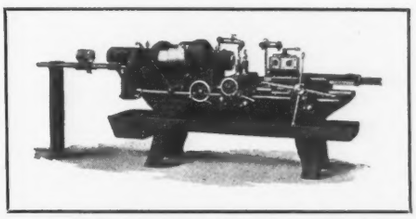
The cut shows the Flather 16″ Double Back Geared Engine Lathe, rigid, powerful, accurate; equipped with a quick change gear mechanism which gives an almost unlimited range of feeds and threads; carefully balanced, with the metal distributed to resist all strains; simple in design—and equipped with the most desirable modern features of a lathe of this type. A *real* Flather Lathe—get the details.

Other sizes, several types, 14″ to 26″. Send for a set of circulars.

FLATHER & CO., Incorporated, Nashua, N. H., U. S. A.



FOSTER UNIVERSAL TURRET LATHES—3 SIZES



FOSTER SCREW MACHINES—5 SIZES

W. A. Barker Wrenchless Chucks Every Movement and Moment Productive



FOSTER MACHINES

The wide adaptability of every machine of the Foster line lends itself to the keen competitive demands of industry today.

Foster machines meet the exacting requirements necessary for turning out high grade work with the maximum of economy, and everywhere they are used their steady and reliable operation proves this.

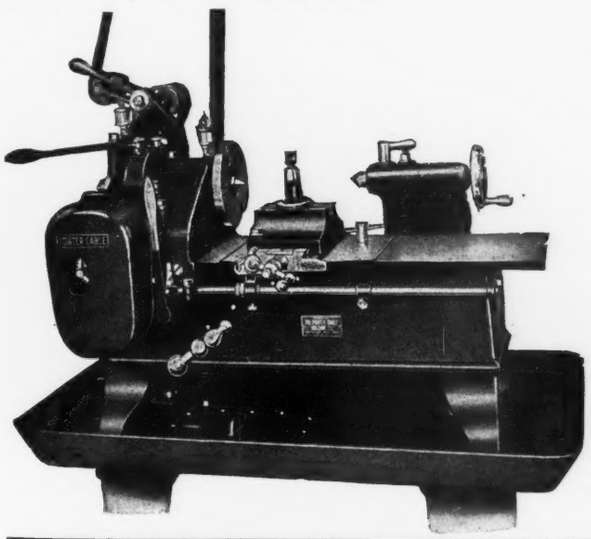
Give our engineers some of your problems. It gives us the opportunity to prove our statements.

FOSTER MACHINE CO., Elkhart, Indiana

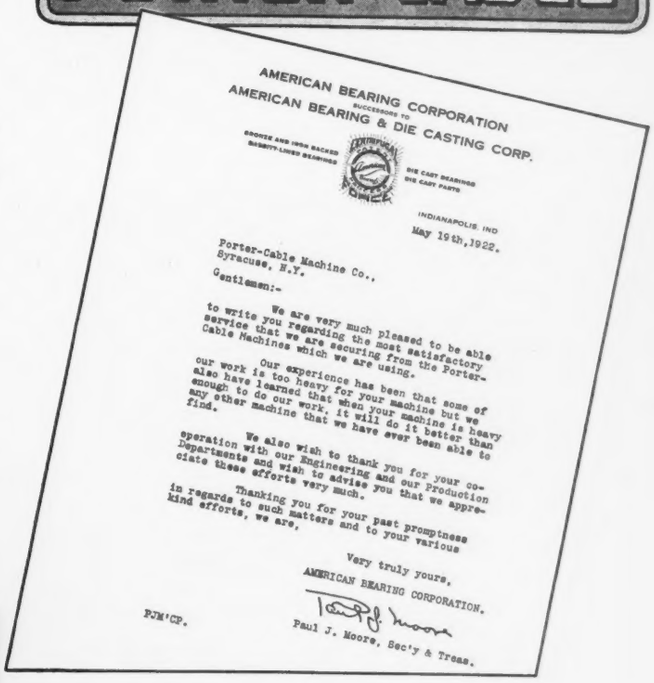
An Endorsement from a Field Where There Are Many P-C Manufacturing Lathes

We gratefully acknowledge Mr. Moore's endorsement of P-C Manufacturing Lathes. We make no claim of universality for them; but we *do* say that work for which they are suited they do "better than any other machine.....".

Let us tell you more about them.



PORTER-CABLE



AMERICAN BEARING CORPORATION
AMERICAN BEARING & DIE CASTING CORP.
SUCCESSORS TO

GROOVE AND IRON BACKED BABBITT-LINED BEARINGS

DIE CAST BEARINGS
DIE CAST PARTS

INDIANAPOLIS, IND.
May 19th, 1922.

Porter-Cable Machine Co.,
Syracuse, N.Y.

Gentlemen:-

We are very much pleased to be able to write you regarding the most satisfactory service that we are securing from the Porter-Cable Machines which we are using.

Our experience has been that some of our work is too heavy for your machine but we also have learned that when your machine is heavy enough to do our work, it will do it better than any other machine that we have ever been able to find.

We also wish to thank you for your co-operation with our Engineering and our Production Departments and wish to advise you that we appreciate these efforts very much.

Thanking you for your past promptness in regards to such matters and to your various kind efforts, we are,

Very truly yours,
AMERICAN BEARING CORPORATION.
Paul J. Moore
Paul J. Moore, Sec'y & Treas.

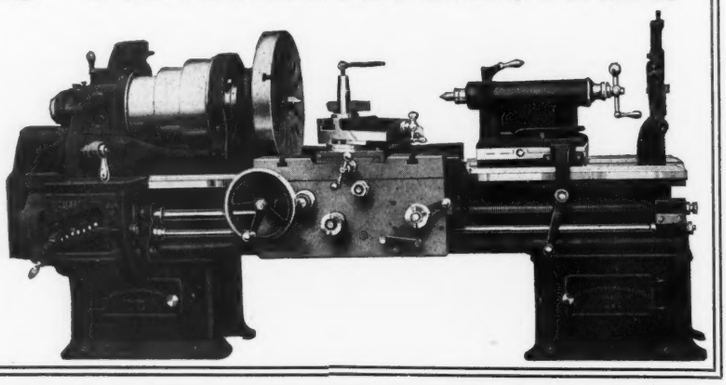
PJM'CP.

THE PORTER-CABLE MACHINE CO.
SYRACUSE, N. Y., U. S. A.

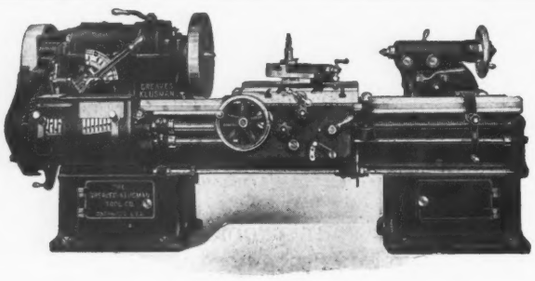
BRADFORD LATHES—Turn Production into Profits

Big, powerful, wide range machines that eat up the work. Easily operated, convenient, durable, Bradford Lathes give profitable service under hard usage—ask the users, we'll tell you where to find some in your locality.

Bulletin 25 describes the entire line.



The Bradford Machine Tool Co.
Cincinnati **Ohio, U. S. A.**



Greaves-Klusman Lathes

Meet Production Requirements

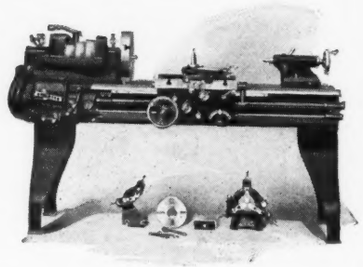
In the Greaves-Klusman Heavy Quick Change Geared Head Type Machine, spindle center is back of center line of bed, and feed rod and lead screw are supported at both ends of apron, the latter being of double plate box form. Steel friction gears in apron have cast iron frictions bolted on, and transmission gears are scientifically hardened and heat treated.

Send for complete "G-K" catalog.

The Greaves-Klusman Tool Co.
CINCINNATI **OHIO, U. S. A.**

Rockford "Economy"

A Double Back Geared Quick Change Engine Lathe, made with 12, 14, 18 and 22 inch swing—the first two well adapted for tool work and light manufacturing, the rest for general service where accuracy and convenience are important. 32 changes of the thread instantly available.



More details on request

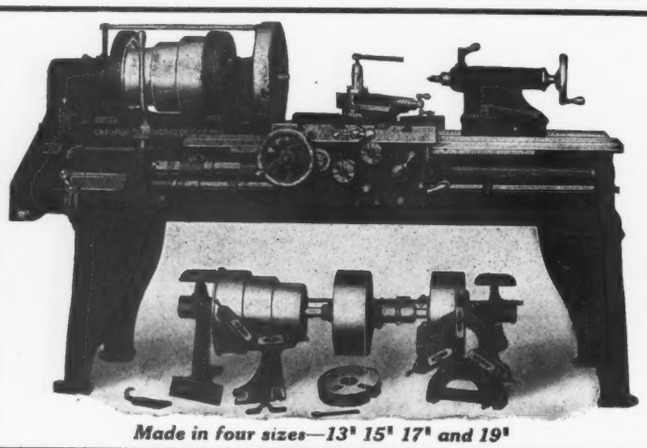
ROCKFORD LATHE & DRILL CO., Rockford, Illinois

The Automatic Machine Company
BRIDGEPORT **CONNECTICUT**
Makers of
AUTOMATIC THREADING LATHES
AUTOMATIC HOB THREAD MILLERS
COULTER MULTIPLE SPINDLE PROFILERS
COULTER SHAPING PLANERS
SPECIAL MACHINE TOOLS

HAMILTON LATHES

Have many good points that will be perfectly apparent when you examine them. Send for the name of the nearest dealer. Look them over.

Hamilton Machine Tool Company
HAMILTON **OHIO**



Made in four sizes—13' 15' 17' and 19'

Champion Lathes

Champion Lathe users are always "Champion" boosters; always glad to show off their machines to interested parties.

Let us tell you who in your locality have "Champion" installations. Seeing what they are doing for your neighbor will help you to estimate their value in your shop.

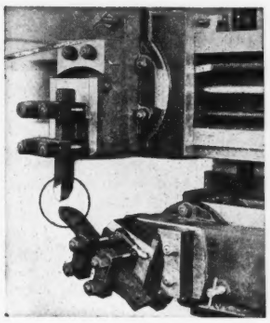
CHAMPION TOOL WORKS
4955 Spring Grove Ave. **Cincinnati, Ohio**

CINCINNATI

PLANERS *Original Thru out* BORING MILLS

SELF-SATISFACTION

is a rust—it dulls brilliance. The world wants new ways of doing old things. Cincinnati Planers fulfill these wants with Rapid Power Traverse, Forced Lubrication, Herringbone Gears, Box Table, Box Arch, Rugged Strength and Accuracy.

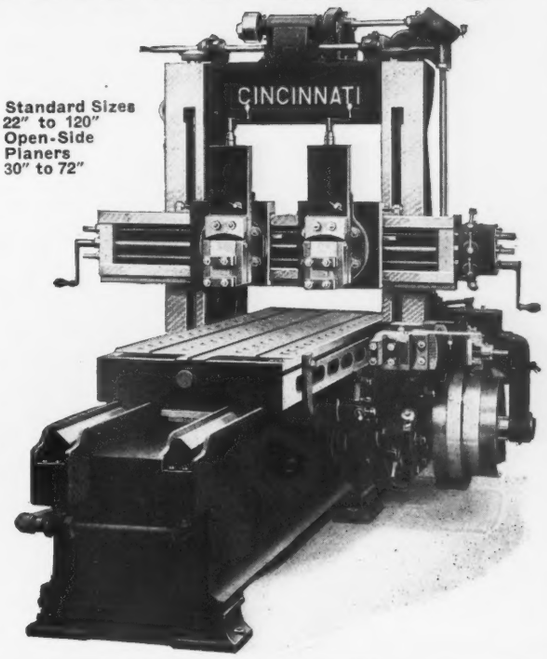


Write for the catalog.

The Cincinnati Planer Co.

Cincinnati O., U. S. A.

Manufacturers of Planers and Boring Mills



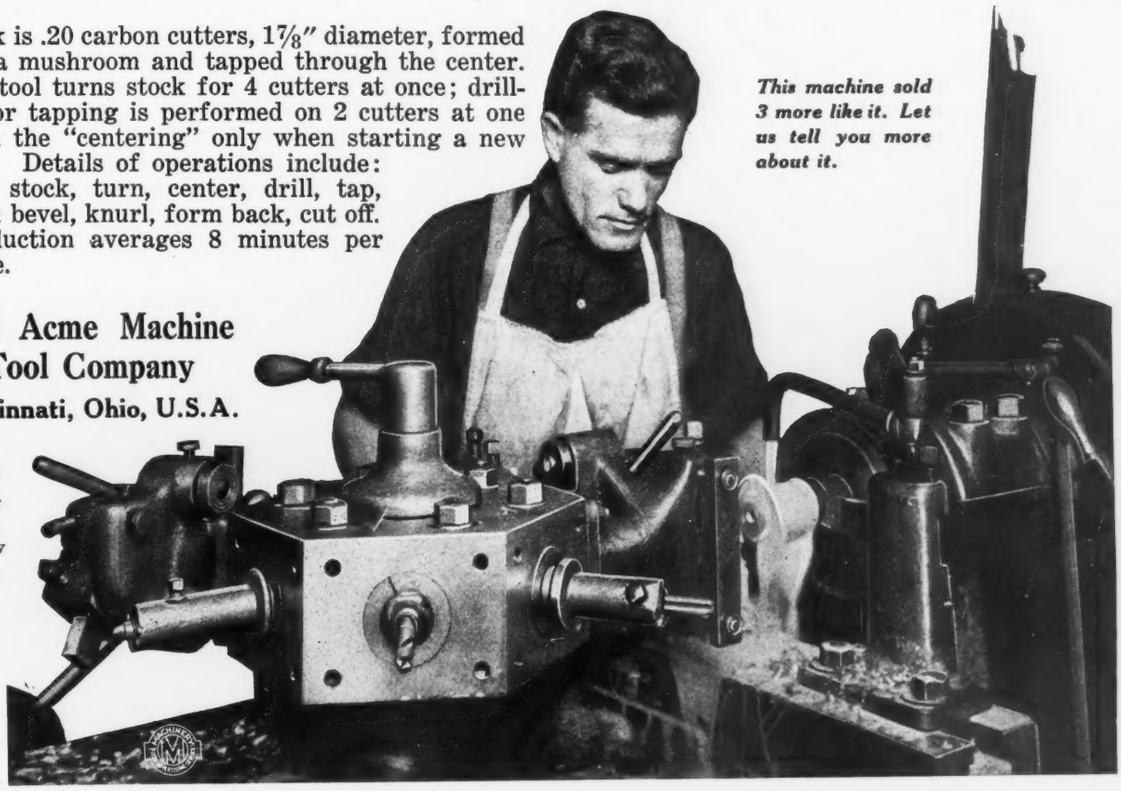
Standard Sizes 22" to 120" Open-Side Planers 30" to 72"

Another Example of the Methods and Results Which Recommend

CINCINNATI-ACME TURRET LATHES

Work is .20 carbon cutters, 1⅞" diameter, formed like a mushroom and tapped through the center. Box tool turns stock for 4 cutters at once; drilling or tapping is performed on 2 cutters at one time, the "centering" only when starting a new bar. Details of operations include: feed stock, turn, center, drill, tap, form bevel, knurl, form back, cut off. Production averages 8 minutes per piece.

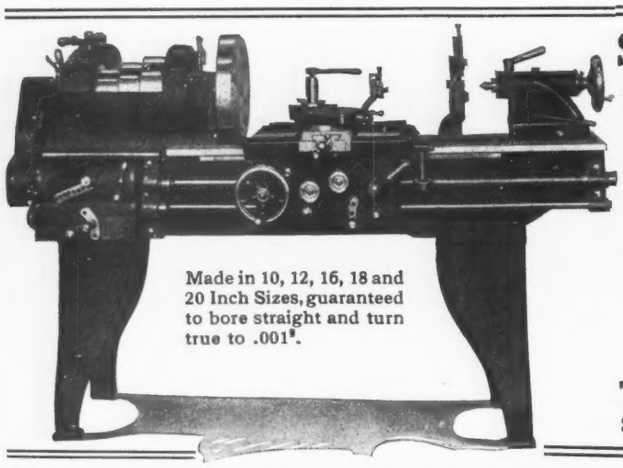
This machine sold 3 more like it. Let us tell you more about it.



The Acme Machine Tool Company

Cincinnati, Ohio, U.S.A.

Agents in all leading cities in this country and abroad



Sidney Standard Pattern Lathes

Every requirement of up-to-the-minute lathe practice is fully met in these completely equipped machines; and every precaution is taken in constructing them to insure accuracy, operating convenience and durability. Point by point, the earning power of the various features we have developed from time to time has made these machines a gilt-edged investment—besides which they are backed by a gilt-edged guarantee.

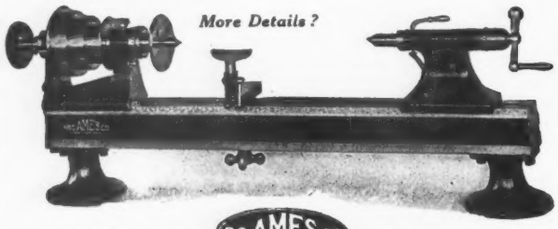
Let us tell you all about them.

THE SIDNEY MACHINE TOOL CO.
SIDNEY OHIO, U. S. A.

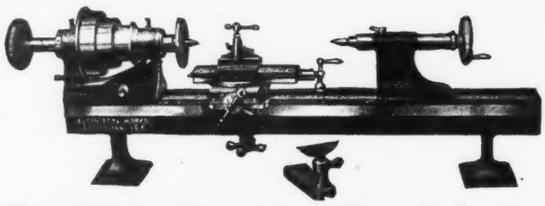
AMES Precision Bench Lathes

For making intricate and delicate parts for instrument and fine toolwork and for small precision manufacturing, you'll find this well-built, "universally" equipped machine well worth its price. Swings 8⅜" diameter 21" between centers.

More Details?



B. C. AMES CO. B.C. AMES CO. WALTHAM MASS U.S.A. **Waltham, Mass.**



The Elgin Precision Bench Lathe

Whether it is for production or for tool room purposes our lathes are equally well adapted.

Just Out:

A circular fully illustrated giving valuable information regarding the various uses of our bench lathes to which they are not commonly put, is now ready for free distribution. Please send for your copy.

ELGIN TOOL WORKS, Inc., Elgin, Illinois

Steinle Turret Machine Co.

THE FULL SWING SIDE CARRIAGE
TURRET LATHE
STEINLE TURRET MACHINE CO.
MADISON WISCONSIN U. S. A.

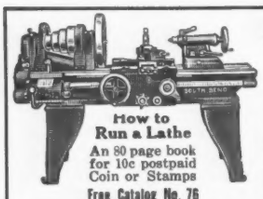
STARK BENCH LATHES

Precision Bench Lathes



Bench Millers

STARK TOOL CO., Waltham, Mass.
Originators of the American Bench Lathe *Established 1862*



Free Catalog No. 76
Established 1906

SOUTH BEND LATHES

Prices within the reach of everybody

	Standard Change Gear	Quick Change Gear
11"x4'	$194.00	$233.00
16"x8'	385.00	436.00

South Bend Lathes are made in eight sizes,—9-inch to 24-inch inclusive.

SOUTH BEND LATHE WORKS
420 Madison St. South Bend, Ind.

Cone 4-Spindle Automatics

Are economical and accurate producers of screw machine parts up to 3½" to 7". They cut costs, increase production, boost profits. Write for particulars.

CONE AUTOMATIC MACHINE CO., Inc., Windsor, Vermont
Agent for Michigan Territory: J. C. Austerberry, 684-690 E. Congress St., Detroit, Mich.

WOODWARD & POWELL

Power, accuracy, operating conveniences—big machines that make profitable production records.

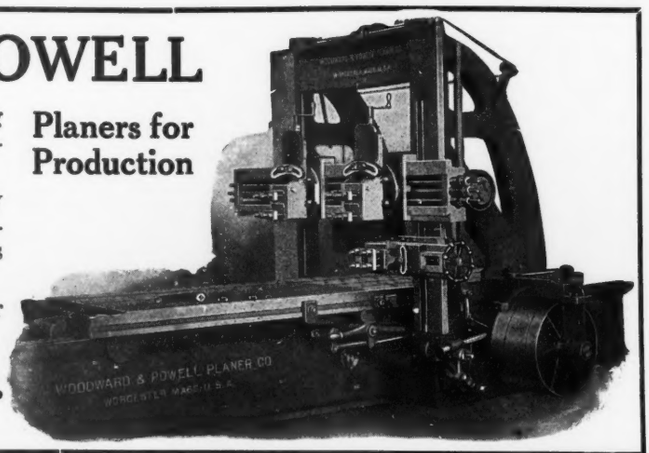
Simple, durable construction, easy accessibility of all working parts and quick, smooth operation insure long service and satisfactory results on all work.

Standard and Heavy Types, Belt or Motor Drive—Circular.

Woodward & Powell Planer Co.

Worcester, Mass., U. S. A.

Planers for Production



Spinning Rivets that Hold!



GRANT RIVETERS

Quickly, easily, *noiselessly* spinning tight or loose rivets on all classes of work in practically every metal; operating profitably in small local shops, fitting readily into the production schemes of big factories with world wide reputations for efficient equipment.

Simple, easily operated and never out of order; profitably productive machines that do not require skilled operators—Grant Riveters are popular wherever they are used.

Let us rivet a few samples for you—and submit production estimates

Grant Manufacturing & Machine Co.
BRIDGEPORT N. W. Station CONNECTICUT

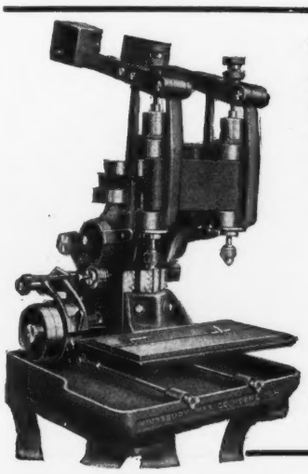
Let Us Tell You All About

The Mueller Radial

and about its records for speed and endurance; for big drilling output and low cost per hole—due to its exclusive I-Beam Column and other exclusive features.

"IT'S A LEADER"

The Mueller Machine Tool Co.
RADIAL DRILLS AND LATHES
Cincinnati Established 1902 Ohio, U. S. A.



The Kingsbury Automatic Sensitive High Speed Ball Bearing Drilling Machine

The adjustable non-positive pressure feed drives the very small drills to capacity without forcing them to the breaking point.

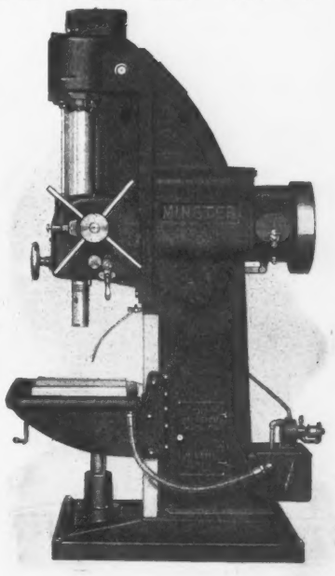
Let us send you details and estimate on your work.

KINGSBURY MFG. CO.
KEENE, NEW HAMPSHIRE

Minster Hi-Duty Drills

Powerful—Productive—Profitable

The weight, power and operating convenience of Minster Drills make them the ideal machines for heavy drilling in solid steel; while the balanced construction and fine adjustments (so easily made) make these big machines equally valuable on finer work. A working range that with great capacity guarantees them an exceedingly profitable investment in any big machine shop.



Three sizes—to drive drills to 2", 2½", 3¼" in solid steel.

The Minster Machine Co.
MINSTER *Get a list of Minster Agents* **OHIO**

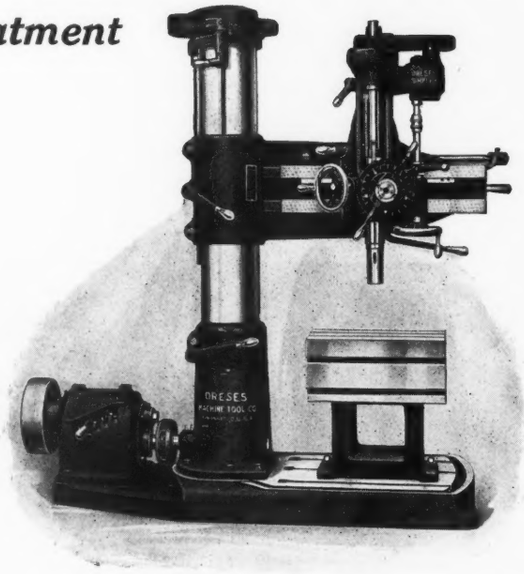
OUR NEW 2½ AND 3 FT.

SIMPLEX RADIAL DRILLS

"Stand Up" Under Hard Treatment

Built for heavy duty, unskilled hands, and places where complicated or delicate tools are undesirable. All mechanisms are simplified to the last degree. This reduces general wear and tear, greatly lessens the chances for sticking, breaking or other trouble, and makes oiling easy.

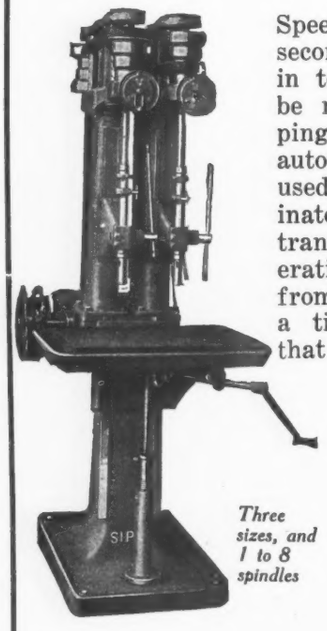
While these machines lack none of the modern features essential for convenient control and rapid production—the price is low enough to bring a really good Radial Drill within reach of every user.



Built in connection with our 3 to 7 ft. Plain and 4 to 7 ft. Half and Full Universal High Duty Radials

DRESES MACHINE TOOL CO., Cincinnati, Ohio

SIPP FEATURES



Speed changes in two seconds, belt changes in ten, all changes can be made without stopping the machine when automatic chucks are used; direct drive eliminates power loss in transmission; every operating move is made from a natural position, a time saving feature that speeds production.

Send for a complete description of the Sipp Quick Change Speed Sensitive Drill Presses.

Three sizes, and 1 to 8 spindles

ITS TRADE A MARK SIPP

THE SIPP MACHINE CO.
PATERSON NEW JERSEY



The Lindgren 20" High Speed All Geared Drill

A powerful machine with back gear, also tapping attachment which can be operated either by hand or foot. Self-oiled with new lubrication features, no leakage of oil. Positive gear feed. Ten speeds with back gear, five without.

Write for descriptive Circular

Mechanics Tool Company
ROCKFORD ILLINOIS, U.S.A.

DRILL IT WITH A HOEFER

This decision will mark the end of your drilling troubles. Hoefer Drillers and Auxiliary Heads do their work in record time.

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HOEFER MFG. CO.
FREEPORT, ILL.

THE MILWAUKEE CRANE

Horizontal Drilling and Boring Machines

Milwaukee Electric Crane & Mfg. Co., Inc.
MILWAUKEE WISCONSIN

CANEDY-OTTO



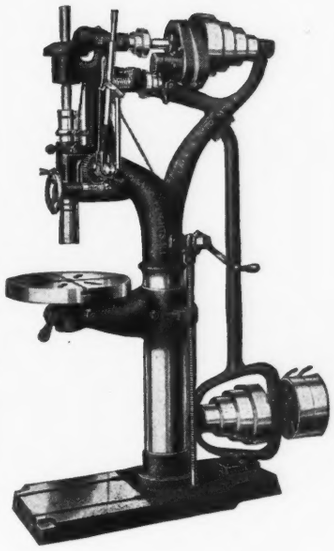
C-O No. 36 Power Drill—A thoroughly high-grade machine tool featuring all the advantages required of such equipment in the most modern machine shops. The .40 point carbon chrome alloy steel spindle is accurately machined and ground and has a ball thrust bearing, and has 12″ travel, doing work heretofore requiring a 24″ or 25″ sliding head drill. The extra large column is bolted to the base by means of a flange. All revolving parts are well balanced to avoid vibration. It has three distinct complete feeds—Power, Wheel and Lever. Bores to center of 21″ circle.

Save Time and Reduce Costs

The advanced design, extreme accuracy and great durability of Canedy-Otto Equipment is saving time and labor costs in thousands of shops, and at the same time bettering the quality of the work turned out.

Fifty years of shop equipment experience stands back of every machine which bears our name. You will find that Canedy-Otto meets the need for high quality equipment at prices which make the work turned out not only completely satisfactory, but also very profitable.

Our complete catalog offers many suggestions for speeding up operations and increasing profits. Write for a copy of this valuable book, or for specific information on needed equipment.



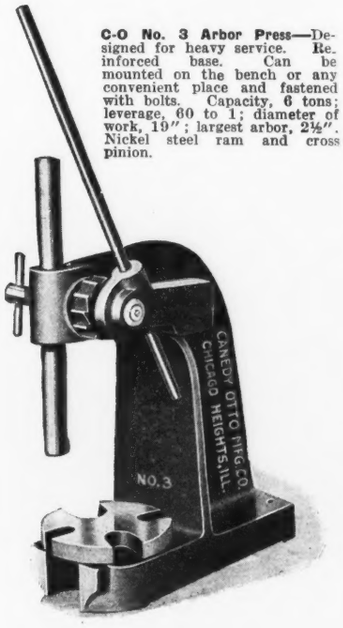
C-O 20-Inch Upright Power Drill With Brace — Canedy-Otto makes the only 20″ drill with 12″ spindle travel, an advantage which has made this model a favorite wherever used. The feed is automatic, powerful and simple. In addition to the hand lever feed, this drill is equipped with a quick return lever for rapid movement of the spindle. Eight speeds are obtained with the back gear. The self-feed worm gear runs in a continuous bath of oil. 12″ spindle travel drills to center of 21″ circle.

ADDRESS DEPT. F

CANEDY-OTTO MFG. CO.

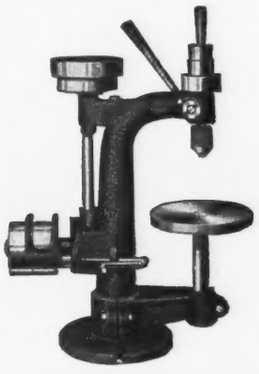
Manufacturers of Automotive Equipment, Drills, Punches, Shears, Shrinkers, Countershafts, Grinders, Buffers, Forges, Blowers, Tuyere Irons, Blast Gates.

Main Office and Factory: CHICAGO HEIGHTS, ILL.
New York Office: Grand Central Palace

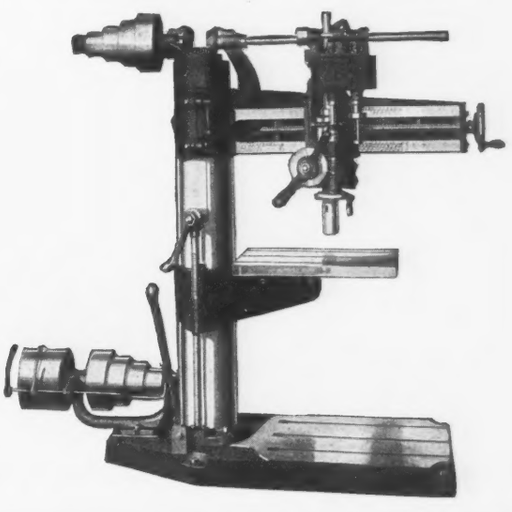


C-O No. 3 Arbor Press—Designed for heavy service. Reinforced base. Can be mounted on the bench or any convenient place and fastened with bolts. Capacity, 6 tons; leverage, 60 to 1; diameter of work, 19″; largest arbor, 2½″. Nickel steel ram and cross pinion.

C-O No. 29 Sensitive Bench Drill—For light and rapid drilling. All parts accurately machined. Pulleys are well balanced for high speed. Power is transmitted to cone pulleys by mitre gears. This design places the cone pulleys in exact alignment and enables the belt to run at maximum speed and also eliminates all twists and turns in belt. Drills to center of 10″ circle.



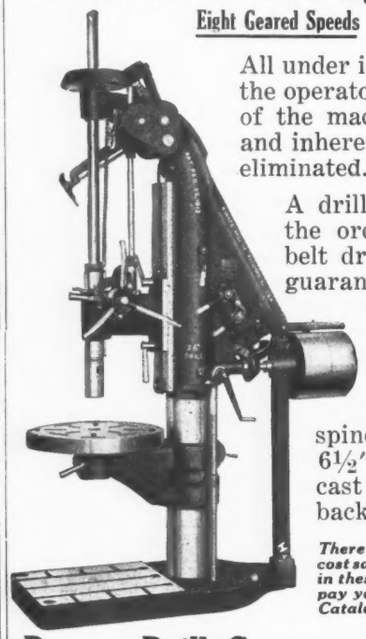
C-O No. 101 Radial Drill—Sells at a moderate price, but is absolutely satisfactory for the most accurate and exacting class of work. Furnished in 2¼′ and 3½′ models. Can also be equipped with improved tapping attachment, operated with foot, leaving the hands free for other work. Fitted with power feed and automatic stop.



For Deep Hole Drilling and Heavy Duty Service You Need Our

All Geared 26" Sliding Head Drill

Eight Geared Speeds Eight Geared Feeds



All under instant control of the operator from the front of the machine. All cone and inherent belt trouble is eliminated.

A drill as powerful as the ordinary 36" cone belt driven drill. Our guarantee is that this drill will drive a 2" high speed twist drill at .041" feed per revolution of spindle, or at rate of 6½" per minute in cast iron without back gear.

There are so many labor and cost saving featurers embodied in these drills that it is sure to pay you to write for complete Catalog "M" describing them.

Barnes Drill Company, 814 Chestnut Street ROCKFORD, ILL.

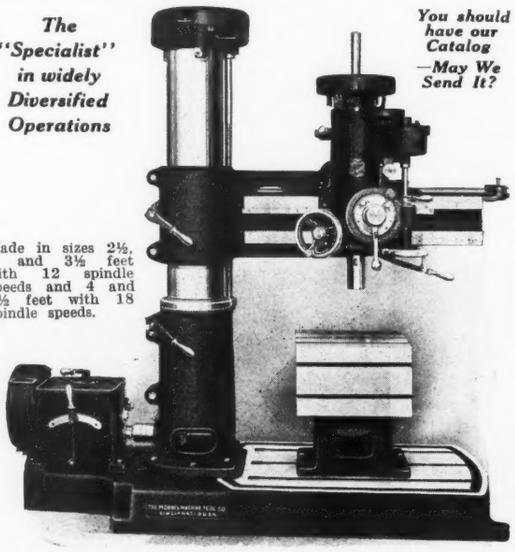
(Incorporated 1907)

Agents for Great Britain: Burton, Griffiths & Co., Ltd.; London, E. C. Belgium: G. & F. Limbourg Freres, Brussels. France: R. S. Stokvis & Fils, Paris. Japan: Roku-Roku Shoten, Tokyo. Spain and Portugal: American Machinery Corporation, S. A. C., Madrid. Sindicato de Marquinaria Americana, Bilbao. New South Wales: R. L. Scrutton & Co., Sydney.

MORRIS RADIAL

The "Specialist" in widely Diversified Operations

You should have our Catalog —May We Send It?



Made in sizes 2½, 3 and 3½ feet with 12 spindle speeds and 4 and 4½ feet with 18 spindle speeds.

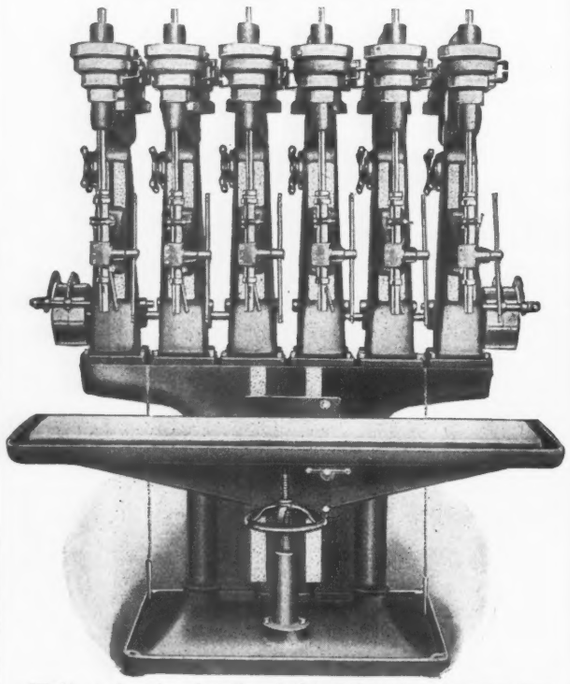
The Morris Radial does many things and does them so well that it is the equivalent of a specially designed machine for each special job. Where rapid positioning for drilling, tapping, facing, counterboring, etc., is required the Morris meets every need. The facility with which its tools are changed widens its scope. Its cost is within reach of every shop.

The Morris Machine Tool Company

Represented by The Niles-Bement-Pond Co., 111 Broadway, New York, N. Y.

CINCINNATI OHIO, U. S. A.

EDLUND



Write today for details of this High Speed, Sensitive Ball Bearing Drilling Machine—1 to 6 spindles; 4 feed changes; endless belt; automatic power feed, etc.

Edlund Machinery Company, Inc.

CORTLAND Box 57 **NEW YORK**

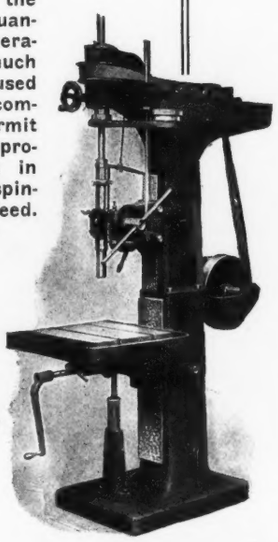
Name of Nearest Agent on Request

How About This?

Avey

No. 3 Heavy Duty Ball Bearing Driller

How about this machine? Isn't it just what you've been looking for to improve the quality and increase the quantity of your drilling operations? Its high speeds—much higher than ordinarily used for ¾" to 1⅛" holes—combined with fine feeds permit of a possible 50 per cent production increase. Built in combinations up to six spindles, hand or power feed. Ball bearings throughout.



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THE AVEY DRILLING MACHINE CO.

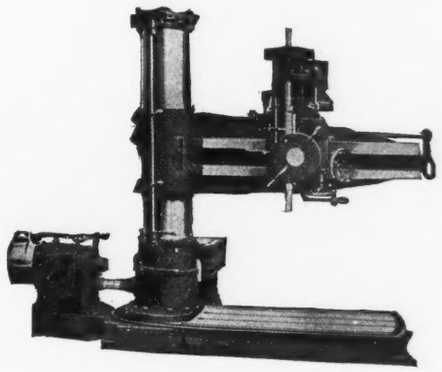
CINCINNATI OHIO, U. S. A.

FOSDICK DRILLING MACHINES

Always Better than the Work Demands

In the 34 years of our drill manufacturing experience we have consistently kept Fosdick Drills just a little ahead of the standard requirements for machines of this type—always ready to meet the advancing standards in drilling practice.

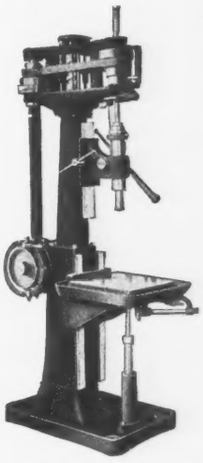
The cuts show:—the Fosdick High Speed Ball Bearing Sensitive Drills, 16″ to 24″ swing, in combinations of one to eight spindles; Fosdick Radial Drills, made in sizes ranging from 2 to 6 feet.



FOSDICK

TRADE MARK REG U S PAT OFF.

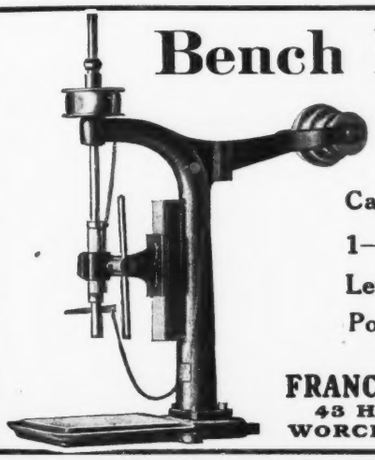
If you need a drill—send for the details of the Fosdick Line.



THE FOSDICK MACHINE TOOL COMPANY

CINCINNATI, OHIO, U. S. A.

Bench Drills



Capacity ½"

1—4 Spindles

Lever Feed

Power Feed

FRANCIS REED CO.
43 Hammond St.
WORCESTER, MASS.

THE ROCKFORD DRILLING MACHINE Co.
·ROCKFORD·
ILL., U.S.A.

Sliding Head Upright Drills

Horizontal Boring Mills

Exclusive Advantages

Details on Request

"HOLE HOG"

DRILLS, REAMS, BORES HOLES IN LINE

A profitable production unit that pays its way in saved time, saved effort, saved patience and increased efficiency.

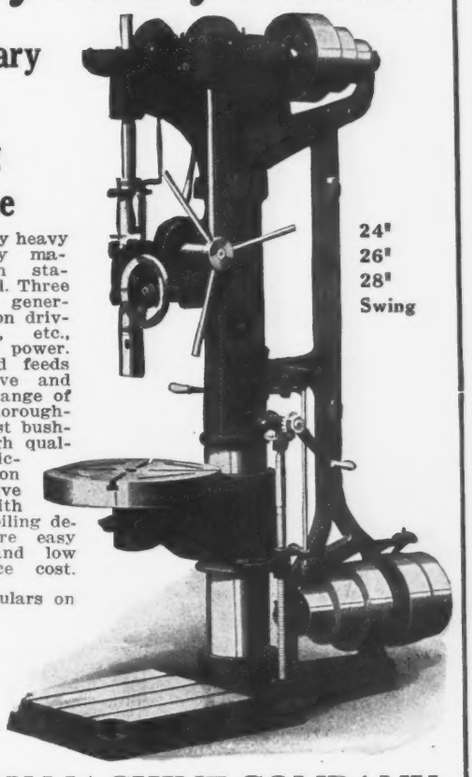
MOLINE TOOL COMPANY, Moline, Ill.

Sibley Heavy Pattern

Stationary Head Drilling Machine

An unusually heavy and stocky machine with stationary head. Three step cones, generous ratios on driving gears, etc., give ample power. Speeds and feeds are selective and cover the range of machine thoroughly. Die cast bushings of high quality anti-friction metal on main drive bearings with improved oiling devices insure easy running and low maintenance cost.

Full particulars on request.



24"
26"
28"
Swing

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SIBLEY MACHINE COMPANY

8 Tutt Street SOUTH BEND, IND., U. S. A.

Seventeen Years Without Repairs!

THE "GIANT" Keyseater

Send for a detailed description of the machine; let us give you other records for service and tell you something about production and operating costs.

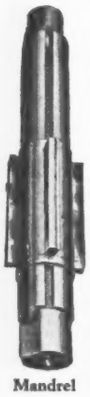


Installed seventeen years ago, in constant operation and *no repairs!* Some record in these days of strenuous production. Working records like this are made possible by simple, durable construction and easy operation. Accuracy is assured by the work holding method. The grooved post which holds the work by its bore also forms a guide for the tool bar supporting it through its entire length and preventing spring.

"GIANT" Keyseaters are made in eight sizes; long wearing, profitable machines whether used for production manufacturing or single operation work.

MITTS & MERRILL
843 Water St. Saginaw, Mich.

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Christiania, Norway and Stockholm, Sweden.

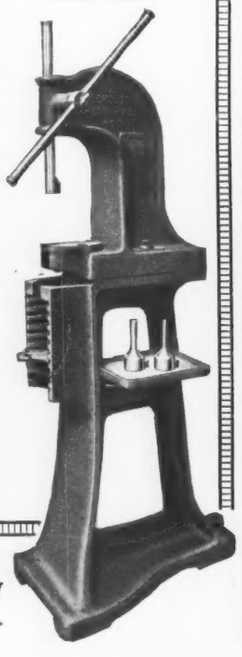


Mandrel

NICHOLSON
Tools You Need

The use of solid mandrels in toolroom and repair shop is a survival of cut-and-try methods which have no place in modern practice.

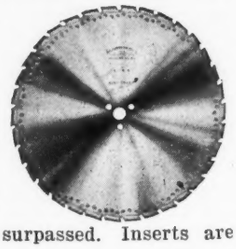
Arbor Press



Nicholson Expanding Mandrels make your operator's time almost wholly productive; assure an instant fit by means of a simple wedge-like expansion as positive, time saving and efficient as the action of Nicholson Arbor Presses in pressing out arbors, punching, bending, broaching, etc. Let us tell you all about them.

W. H. Nicholson & Company
112 Oregon Street, Wilkes-Barre, Pa.

HUTHER BROTHERS' SAWS
Help You Meet Lower Prices In Times of Depression



Huther Brothers' Inserted Tooth Milling Saws have the ability to lower production costs, and they are daily proving it in the hands of users. Huther inserts can be worn down to 3/16" from the heel before replacing. This allows 1¾" wear—a cutting service that is not surpassed. Inserts are replaced at small expense.

Send for your copy of complete catalog.

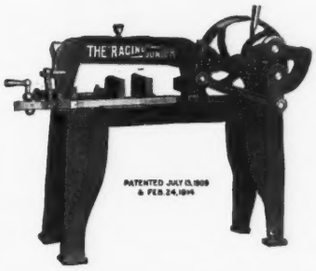
HUTHER BROS. SAW MFG. COMPANY, Inc.
ROCHESTER, N. Y.

BARNES
SAWS FOR METAL
BAND MANUFACTURED BY HACK
DETROIT W.O.BARNES CO. MICHIGAN

Lea Simplex Cold Saws

Economy in cold sawing is just as important as in any other machine shop operation—our booklet gives valuable information on this subject and tells all about the results obtainable with Lea Simplex Cold Saws. Send for it.

The Earle Gear & Machine Company
4707-15 Stenton Avenue PHILADELPHIA, U. S. A.
Also Manufacturers of Cut Gears, Special and Bridge Operating Machinery and Earle Centrifugal Pumps



More Work at Less Cost

"RACINE" *High Speed* **METAL CUTTING MACHINES**

Racine High Speed Metal Cutting Machines will cut more metal in less time, at lower cost, and more accurately than any metal saw on the market. A saw blade on a "Racine" will usually outlast five blades on the ordinary metal saw. This is due to the **positive return lift** of the **Racine.** The blade does not drag on the work on the return stroke, and cannot bind or break. Because of this feature, maximum speed, accuracy, and economy are achieved. Let us send you the full facts—descriptive information and prices. There is a "Racine" of the right size to meet your requirements.

RACINE TOOL & MACHINE CO.
250—15th St. Racine, Wis., U. S. A.

Mechanical Lift-Positive Draw Cut

STERLING
HACK SAW BLADES

Finest grade rolled high-tungsten alloy steel, made by special machines and processes. Free-cutting, long-lasting, tough. Sterling Hacksaw Blades, Frames and Machines are for sale everywhere. Ask for them.

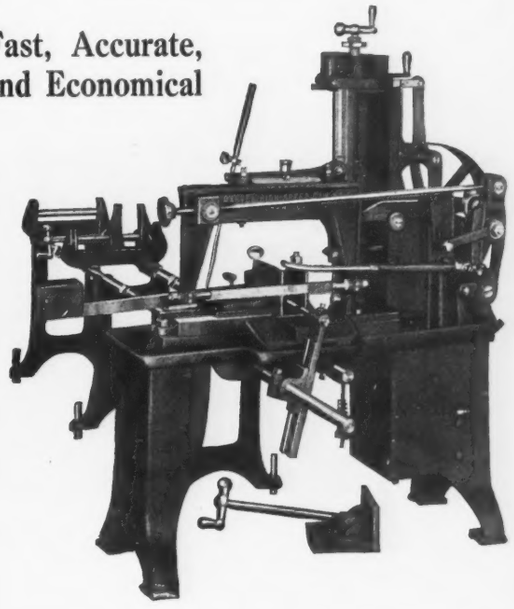
Diamond Saw & Stamping Works
357-361 Seventh St. BUFFALO, N. Y.



The Hack Saw that is Entirely Automatic

The Marvel Hack Saw No. 5

Fast, Accurate, and Economical



After each cut, raises the saw, opens the vise, feeds the bar forward to the gauge, closes the vise and starts the new cut, cutting off piece after piece ALL AUTOMATIC and at HIGH SPEED.

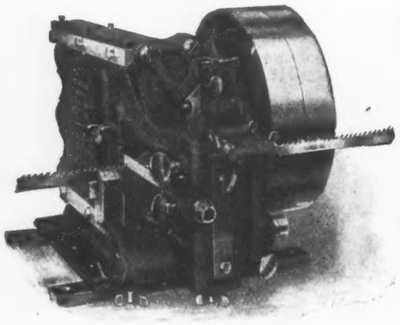
IT IS IN CONSTANT USE everywhere in shops large and small. It quickly pays for itself in the saving of time, labor and blades, and it piles up the duplicate pieces at a surprising rate.

Put this saw to work in your shop or stock room and have the satisfaction of *greater and faster production at less cost.*

Write to us for details.
We gladly furnish full information.

Send for the circular of Marvel Hack Saws, Band Saws, Shears, Punches and Drill Press Vises, and investigate these efficient tools.

Armstrong-Blum Mfg. Co.
343 North Francisco Ave. CHICAGO, ILL., U S. A.



SAW COSTS REDUCED

MODEL K—FILES, SETS AND JOINTS BAND SAWS
→ IN ONE OPERATION ←

No other machine performs these two operations at one time. This saves a second machine, the extra handling of the Saw and

ONE-HALF THE TIME SAVED

Over other mechanical methods and

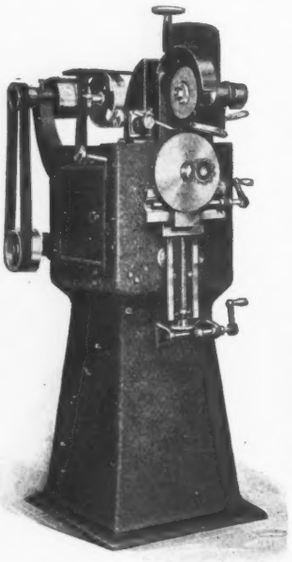
1/40 THE TIME REQUIRED FOR HAND WORK

In use by practically all large saw makers and manufacturers.

THE WARDWELL MANUFACTURING COMPANY

108 Hamilton Ave. *Metal Cutting Circular Saw Grinders and Filers, Hack Saw and Metal Cutting Band Saw Grinders, Lap Grinders, Circular Saw Setters, etc.* Cleveland, Ohio.

For Cutting Off Metal Plates, Bars, Discs or Rolls, for Slotting and all kinds of Metal Sawing



Use metal cutting saws whose teeth are properly shaped and spaced for the work, automatically and uniformly maintained as the saw wears down. Skilled operators not required with our automatic grinders for keeping metal cutting saws up to highest efficiency.

High cost for ruined saws now eliminated.

Saws properly fitted will cut faster, last longer, never break or crack. Old saws formerly discarded now reclaimed and made good as new.

Our automatic sharpeners will add at least 50% to your sawing service.

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Machinery Company of America

Big Rapids, Michigan, U. S. A.

The HIGLEY

COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.

New York Philadelphia New Haven

QUALITY

HACK SAWS

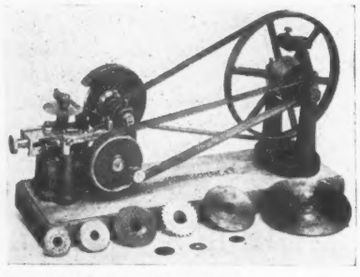
"True to the Name"

Specify Quality on your next order and Settle Your Hack Saw Problem.

Napier Saw Works, Inc.
(The Hack Saw Specialists)
Office & Factory, Middletown, N. Y.

SCHERR AUTOMATIC SAW SHARPENER

Costs Little—Saves Much



Capacity for saws 1½" to 6" in diameter, 3/32" thick.

An inexpensive machine that pays big dividends. Get a circular for details and *price*.

GEORGE SCHERR, 126A Liberty St., New York

Peerless HIGH SPEED Hack Saw Machines

Unequalled for fast, accurate, economical cutting of bar steel. The new UNIVERSAL SHAPING SAW will do your hack sawing, also many slotting, shaping and other operations.
Peerless features—overbalanced saw frame—Automatic lift and positive feed control—Greater production with less blades.

Peerless Machine Co., 1611 Racine St., Racine, Wis.

SCREENS OF ALL KINDS

Chicago Perforating Co.
Tel. Canal 1459 2445 West 24th Place CHICAGO, ILL.

Perforated Metal Machinery Guards

STAR Hack Saws



HACK SAWS OR WAGES?

Have you figured out just when it pays to save saws and when to save wages on hack sawing?

This and many other practical points are covered in our interesting new book on the "Use of Hack Saws." It shows you how to select the right blade for given work and conditions and helps you find the right speed and pressure after the blade is selected. Shows you the causes and remedies for blade breakage, crooked sawing, and rapid dulling of teeth.

A book that will help you get better results from your sawing. Written by Mr. George N. Clemson and embodies his 35 years' experience in making and using hack saws.

Free on request. Ask for Booklet A.

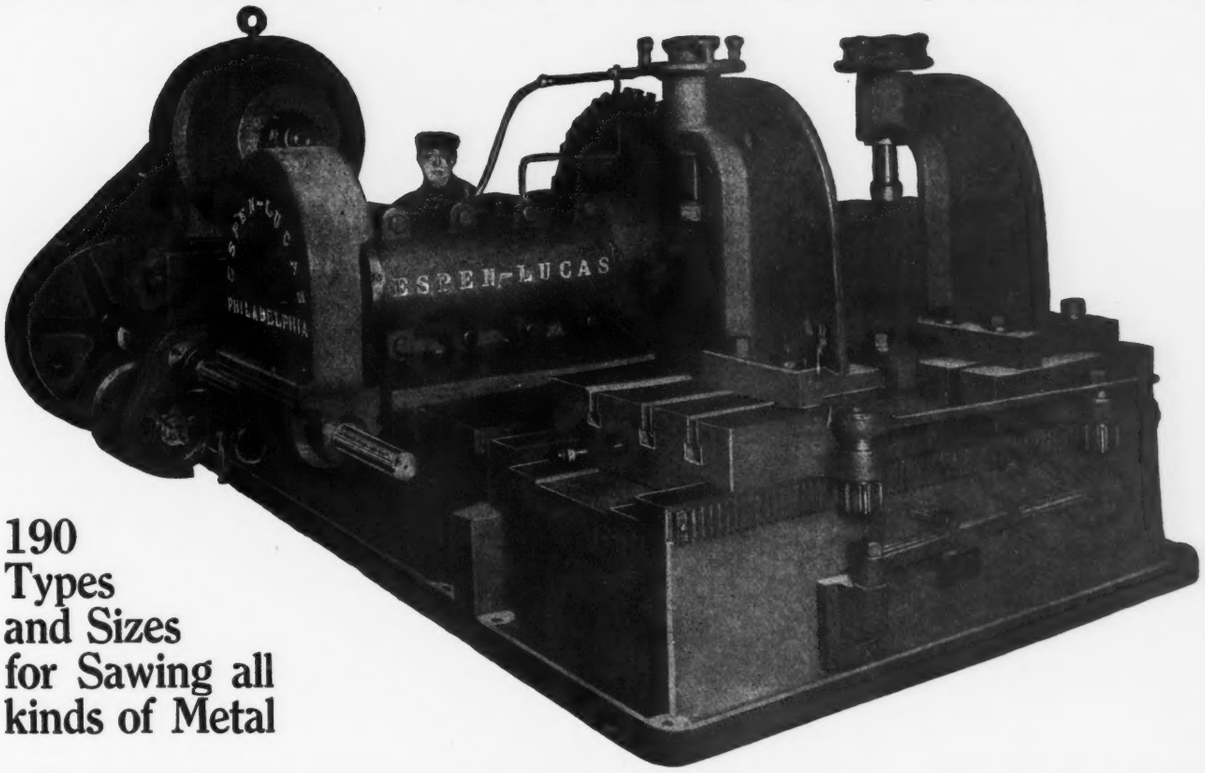
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CLEMSON BROS. Inc.

MIDDLETOWN, N.Y.

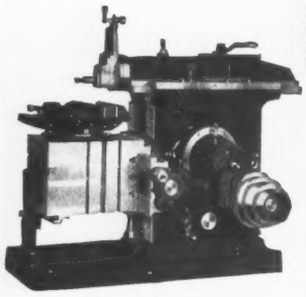
Makers Since 1883

One of the Fastest Cold Sawing Machines in the World



190
Types
and Sizes
for Sawing all
kinds of Metal

THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues **PHILADELPHIA, PA.**



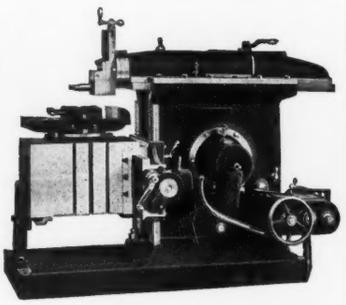
Cone Drive
16, 20, 24, 28, 32 Inch

Columbia Shapers

Mean Better, Faster Production

Their great capacity and power; their convenience; and their thoroughly high class workmanship, enable them to set the pace for accurate, rapid production.

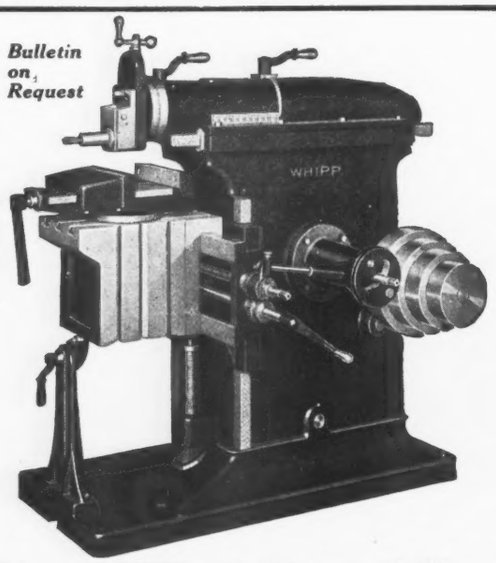
It pays to use them—prices and full particulars on request.



Speed Box, Friction Clutch and Brake and Single Pulley Drive

THE COLUMBIA MACHINE TOOL COMPANY, Hamilton, Ohio

Bulletin on Request



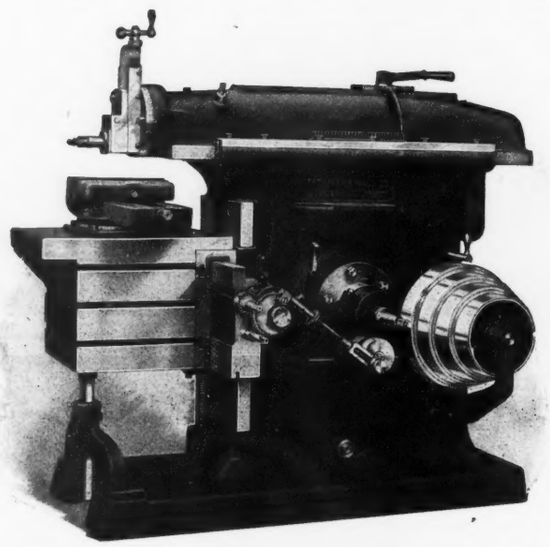
Whipp 20" Back Geared Shaper

Whipp Shapers are designed and built for manufacturing and toolroom work. They show the same economy and efficiency in either department. High grade equipment; maintaining unusual accuracy and giving satisfactory results in product and profit. They cost no more than you ought to pay—come in sizes 12, 14, 16, single geared and 16, 20 back geared.

THE WHIPP MACHINE TOOL CO.
SIDNEY, OHIO, U. S. A.

WE CONFINE OURSELVES TO BUILDING

Shapers Exclusively



Crank Sizes: 12", 14", 16", 20", and 25"—Either Cone Driven or through Speed Box, 28" and 28/32" B. G. All Geared Single Pulley Drive

The Smith & Mills Company

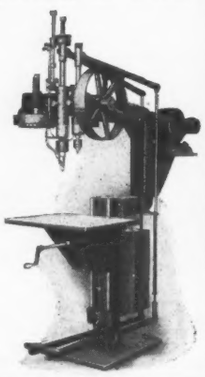
CINCINNATI OHIO, U. S. A.

FOREIGN AGENTS: G. & F. Limbourg Freres, Brussels, Belgium; Burton, Griffiths & Co., Ltd., London, England; Van Rietschoten & Houwens, Rotterdam, Holland; Reid Brothers (Johannesburg) Ltd., Johannesburg, South Africa; J. Lambercier & Co., Geneva, Switzerland; Zurich, Switzerland; V. Lowener, Copenhagen, Denmark; Christiania, Norway; Stockholm, Sweden; H. P. Gregory & Co., Sydney, N. S. W.; Rene Berndes Co., Havana, Cuba; Horne Company, Ltd., Tokyo, Japan; Daniele Stussi, Milan, Italy.

Magazine Fed Screw Driving is Two to Six Times Faster

Tell us the size of your work and gauge and length of screws, and we'll tell you how much a "Reynolds" will increase your output—by means of the Magazine Feed and Foot Lever Control, which leave the operator's hands free to position the work.

Screws set flush or to any desired depth. No marred work or screw heads.



Made in many sizes. No skill required

The Reynolds Machine Co.
Dept. M. (Information)
Massillon Ohio, U. S. A.

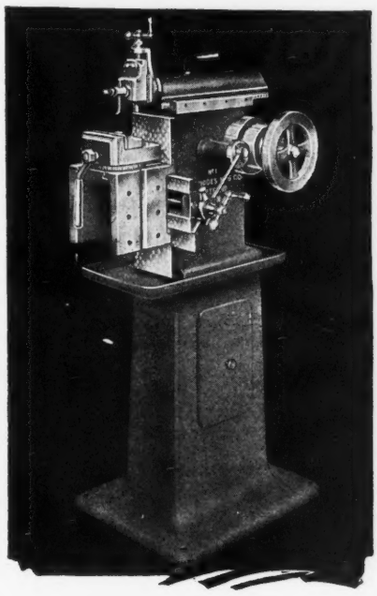
ASA S. COOK CO.
AUTOMATIC WOOD-SCREW MACHINERY
For Making IRON AND BRASS WOOD-SCREWS

Machines built to capably produce accurately cut screw slots, screw threads and gimlet points. Modern up-to-date equipment furnished for Wood-Screw Plant installations.

Send for Catalog 7-H HARTFORD, CONN., U. S. A

THE OIL AND WASTE SAVING MACHINE CO.
PHILADELPHIA, PA.

Chip Separators Oil Filters Oil Reclaiming Machines
Waste Reclaiming Machines
Original Belgian Machinery Wiping Towels



RHODES

Horizontal Crank Shaper

$195.00

Dependable tool room equipment is invariably expensive, but we here show the exception to the rule. The Rhodes Shaper was developed to cope with a broad range of machining operations on small tool and die work.

Absence of complications insures smooth manipulation and masterly workmanship prolongs service life.

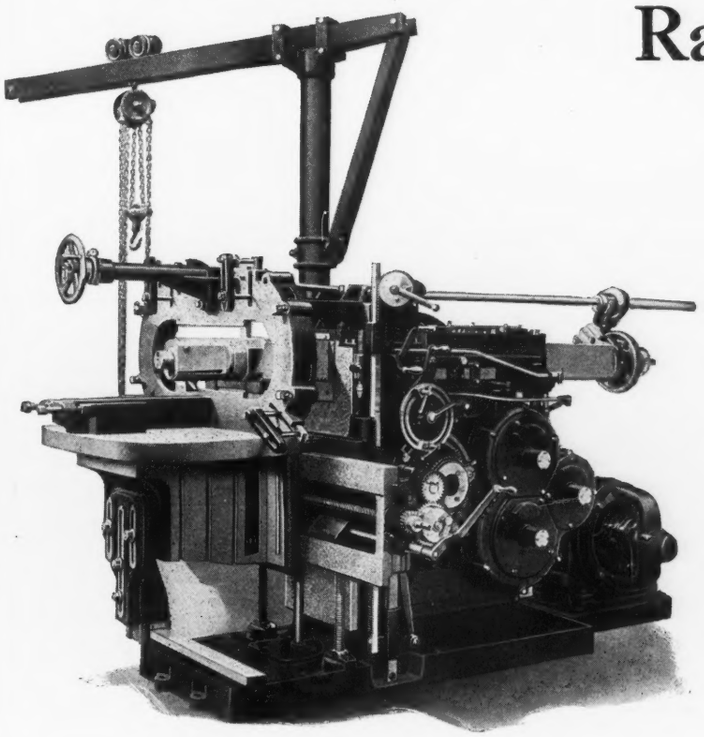
The "Rhodes" is not a cheap machine as the details will prove.

Send for a copy of Catalog M-22 and examine the details.

THE RHODES MANUFACTURING COMPANY

984 Park Street **HARTFORD, CONN.**

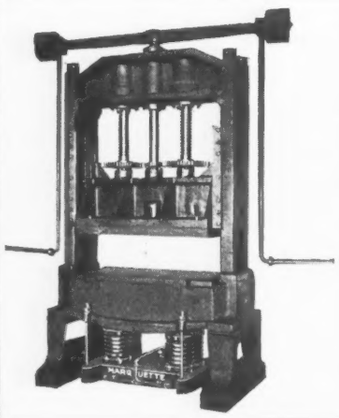
A Special Heavy Duty Morton for Railroad Work



Maximum rigidity, ample power for deep, rapid, heavy cuts. A multi-duty rapid production machine designed for railroad shop use, particularly profitable wherever a wide variety of big work is performed. Send for circular 6-D. Let us show why the draw cut principle saves power and betters the result.

Morton Manufacturing Company

Muskegon Heights
MICHIGAN, U. S. A.



EFFICIENT PRESS EQUIPMENT MEANS EFFICIENT STAMPINGS

The picture shows a TOLEDO SCREW PRESS equipped with four Marquette Pneumatic Die Cushions at the plant of the TOLEDO MACHINE & TOOL COMPANY for the trying out of sheet metal drawing dies of large size.

Power presses equipped with Marquette Pneumatic Die Cushions are more efficient because they turn out stampings free from wrinkles and cracks.

Submit your stamping problems to our engineering department, and let us help you solve them.

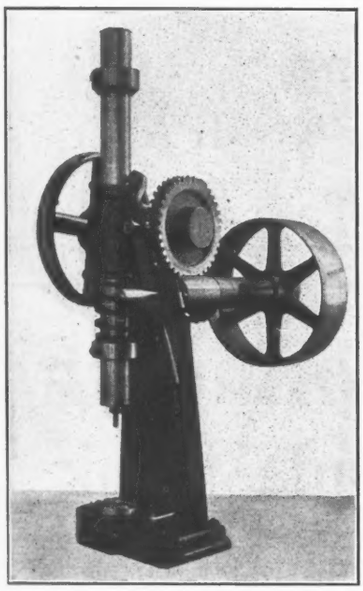
MARQUETTE TOOL & MFG. COMPANY

321 W. OHIO STREET CHICAGO, ILL., U. S. A.

AMERICAN

Power Bench Broach Press

Pays Its Way Into Your Employ



In all parts of the country, in machine shops, garages, service stations, the famous American Power Bench Broach Press and Assembling Press is earning its way into the good opinions and regard of its users.

$120.00 and up
F. O. B. Ann Arbor, Mich

That's the American's price—in some shops it has paid its cost back in a comparatively short time, making all later earnings "velvet." There is no overhead. It takes work 6" diameter, height from table to end of ram 13" maximum, capacity 1½ tons, ram 2" diameter, drive belt 2½", automatic stops on cutting stroke and return, speedy in operation, well made, absolutely reliable.

American Broach & Machine Company

Builders of all types of Broaching Machines and Broaching Tools.

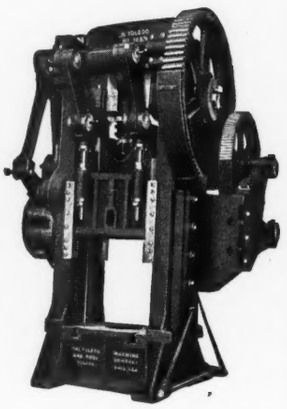
Ann Arbor Michigan

Detroit Office, 305 Scherer Bldg.

THE "TOLEDO"

Patented Single and Double Crank Toggle Drawing and Deep Stamping Presses

Just one of a line which includes machines of all sizes for every conceivable metal stamping and forming purpose.



"Toledo" Patented Toggle Drawing Presses have an especially designed blank holder control mechanism that insures the correct dwell of the blank holder during the entire operation—one of the features that make these carefully balanced, powerful machines such satisfactory producers.

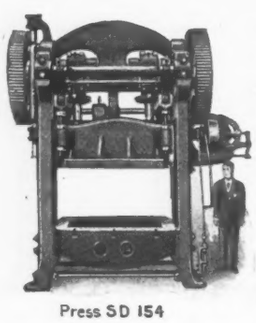
Find out more about "Toledo" Presses
"Presses for Every Purpose"

The Toledo Machine & Tool Company

TOLEDO, OHIO

Chicago Office: Room No. 611 Machinery Hall
549 West Washington Boulevard

FERRACUTE PRESSES



Press SD 154

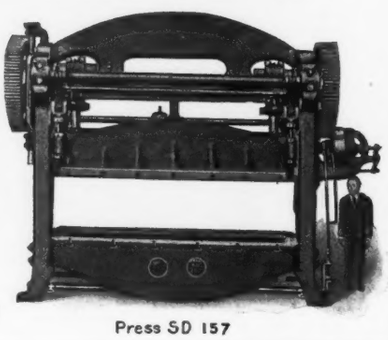
FOR CUTTING AND FORMING METALS

The machine at the left is a Double-action Toggle Drawing Press exerting 150 tons pressure and having a width between columns, right to left, of 76 inches. Weight about 64,000 lbs.

The machine at the right is a similar press but 148 inches wide between columns and weighing about 92,000 lbs. Presses are built having same tonnage but with one pitman and less width. Also for pressures up to 2000 tons.

PRESSES FOR EVERY PURPOSE

FERRACUTE MACHINE COMPANY, Bridgeton, New Jersey



Press SD 157

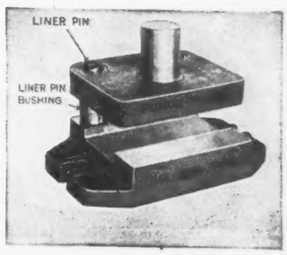
DIAMANT Standard Punch and Die Sets

IN STOCK FOR IMMEDIATE DELIVERY

Have Your Punch and Die Sets Made by DIAMANT of Newark.

Full sets with Plates, Screws and Dowels, or 4-component sets comprising Holder, blank Shoe, Pins and Bushings. Accurately constructed, rigidly inspected and guaranteed to function properly.

Write to us or to our local representative for detailed information and prices.

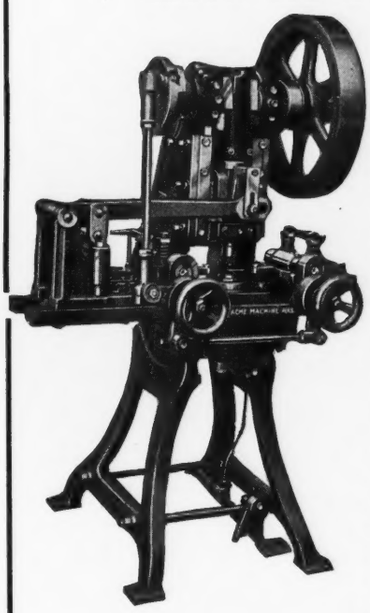


ONE OF MANY STANDARD TYPES. Type ULR. U-lug Die Shoe—Lengthwise Slot. Rear Liner Pins, Plates, Dowels and Screws also furnished.

DIAMANT TOOL & MFG. CO., Inc., 95 Runyon St., NEWARK, N. J.

REPRESENTED BY: Russell, Holbrook & Henderson, Inc., 30 Church St., New York City. McMullen Machinery Company, 64-66 Iona Ave., Grand Rapids, Mich. The Cleveland Duplex Machinery Co., Inc., 1224 West Sixth St., Cleveland, Ohio. Samuel W. Hayes' Sons, 1410 Keenan Bldg., Pittsburgh, Pa.

Turn Your Presses Into Automatics



By using our Combined Roller Straightener Roll Feed and Scrap Cutter

and increase your production enormously.

ONE MAN

can run from two to three presses using coil stock and turn out from six to nine times what can be obtained by hand feeding.

F. J. LITTELL MACHINE CO.

Successors to

ACME MACHINE WORKS

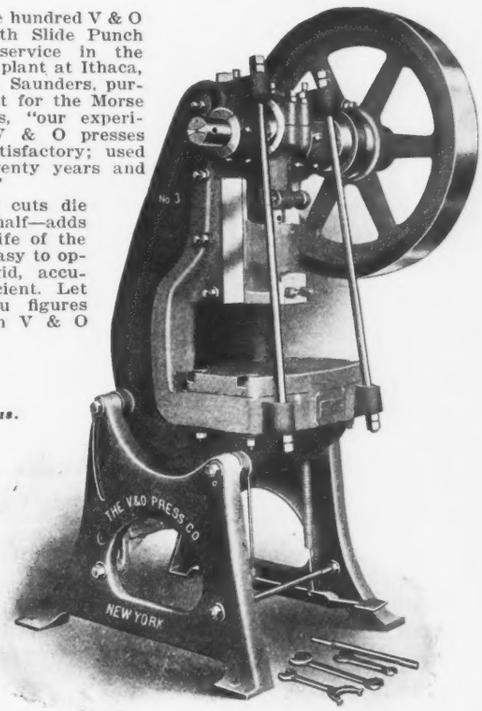
4127 Ravenswood Ave. CHICAGO, ILL.

One Hundred V & O Presses Like This in Morse Chain Company Plant

There are one hundred V & O Double Length Slide Punch Presses in service in the Morse Chain plant at Ithaca, N. Y. C. L. Saunders, purchasing agent for the Morse people writes, "our experience with V & O presses has been satisfactory; used them for twenty years and still buying."

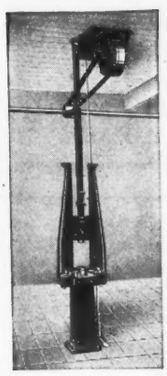
The V & O cuts die expense in half—adds 50% to the life of the dies. It is easy to operate, is rigid, accurate and efficient. Let us send you figures and facts on V & O production.

Write us.



THE V & O PRESS COMPANY

100 Dry Harbor Road (Glendale) BROOKLYN, N. Y.



"PECK"

Automatic Drop Lifters

will convert those hand or foot drops and unsatisfactory automatics into

PRODUCTIVE AUTOMATIC DROPS

Capacity 15 to 5000 pounds

DROP PRESSES for all purposes

MINER & PECK MFG. CO.

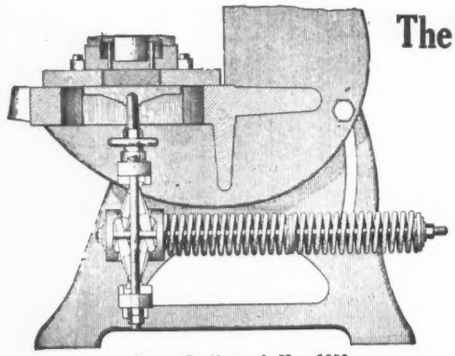
DERBY, CONN.

Forging Rolls
Drop Hammers
Yeakley Hammers
Presses
Plate Shears
Multiple Punches
Multiple Tapping Machines
Punches and Shears, Etc.

WILLIAMS, WHITE & CO.

MOLINE, ILL., U. S. A.

THE BULLDOZERS



Cross Section of No. 1050
King Pressure Toggle Applied to Press

The King Pressure Toggle for Single Action Presses

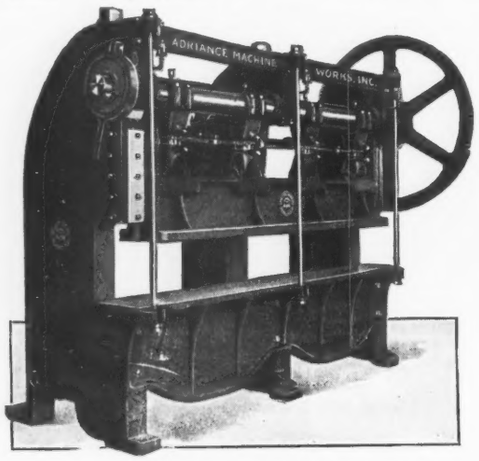
This device equips single action presses to handle toggle press jobs, saving 25 to 45% on labor and 40 to 60% on first cost of equipment.

It saves time, space and the number of operations, and reduces to a minimum the number of presses required for handling a given volume of work. Made in ten sizes suitable for various requirements in drawn work up to 30 inches in diameter and 8 inches deep.

Write today for particulars that will convince you of the adaptability of this device for handling your work.

R. D. KING, Monadnock Block, Chicago, Illinois

THE WORLD'S STANDARD



"ADRIANCE"
QUADRUPLE CRANK PRESSES

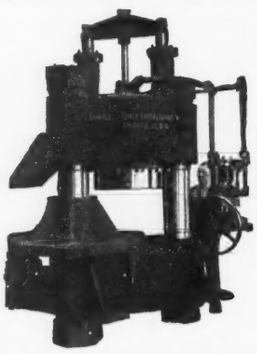
Especially adapted for work requiring an extra wide bed, for the manufacture of metal doors and cornices, window frames, sliding door tracks, and with slight modifications may be adapted for gang punching and perforating.

ADRIANCE MACHINE WORKS, Inc.
Established 1888
78 RICHARDS STREET BROOKLYN, N. Y.
Incorporated 1913

Punching and Shearing Machines
"THE QUALITY LINE"

Alligator Shears
Angle Iron Shears
Bar Iron Shears
Billet Shears
Squaring Shears
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Plate Splitting Shears
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Vertical Punches
Boiler Punches
Bulldozers
Horizontal Punches
Multiple Punches
Structural Punches
Board Drop Hammers
Helve Hammers, etc.
Spacing Tables

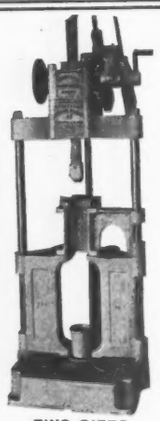
THE LONG & ALLSTATTER CO.
HAMILTON OHIO, U. S. A.



HYDRAULIC and SPECIAL MACHINERY

Built to Order
Large or Small Work
Our Engineering Dept. is at your service.
5000 Patterns in Stock.

Charles F. Elmes Engineering Works
222 No Morgan St. *"Since 1851"* CHICAGO, U. S. A.



TWO SIZES

EVANSVILLE ARBOR PRESS
Quadruple—Compound

The Evansville has unusual range and capacity. It develops 30 to 40 tons pressure; has anti-friction roller on compound pin assuring long life; double pinions on compensating ram, which is made in two parts, equalizing pressure on every tooth; all wearing parts are heat treated; pawl takes up back-lash; light weight; sturdy construction; an auxiliary handle for light work. There are numerous other features worthy your investigation—why not write us for complete data?

THE EVANSVILLE ARBOR PRESS COMPANY
EVANSVILLE INDIANA

PRESSES AND SHEARS
SHEET METAL WORKING MACHINERY

THE D. H. STOLL COMPANY Inc.
Military Road and Grote Street BUFFALO, NEW YORK

AUTOMATIC BAIRD MACHINE CO. BRIDGEPORT, CONN. MACHINERY

PRESSES—Foot and Power.
WIRE FORMING MACHINES—Standard or special.
TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.

BAIRD MACHINE CO.
BRIDGEPORT, CONN.



1800-Ton Hydraulic Die Press

This 1800-Ton Hydraulic Die Press

is just an example from our large line of Hydraulic Presses designed for die forming, forcing, etc., and by the addition of plates to the platens, adaptable to a wide range of heating and chilling operations. Nothing but the best grade of material is used throughout these presses, making them machines of long service.

Other machines of our manufacture are benders, bulldozers, jacks, pit jacks, shaft straighteners, rail benders, punches, shears, wheel presses, forcing presses, forging presses, crankpin presses, pumps, accumulators, valves, etc.

Write for Catalogs

THE WATSON-STILLMAN CO.
192 Fulton Street, New York
McCormick Building, Chicago
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433

H-P-M Hydraulic Machinery

OFFERS ECONOMICAL SOLUTIONS

FOR forming and molding bakelite, condensite and similar substances.

FOR broaching, die sinking, drawing, forcing, forming, flanging, lead molding, briquetting, bending, veneering, extruding, etc.

FOR extracting oils, fruit juices, greases, etc.

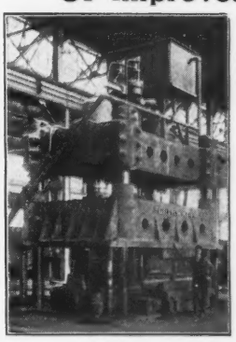
FOR baling cotton, wool, herbs, paper and other loose materials.

In fact we have an H-P-M Hydraulic Press, Pump, Valve or Fitting for every High Pressure Purpose. State definitely what you wish to press, we will send proper information.

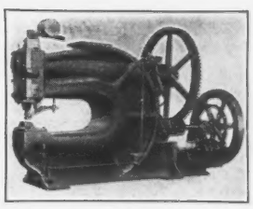
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84-88 Lincoln Ave. Mount Gilead, Ohio
New York Buffalo Cleveland

Hydraulic Presses For All Purposes

Of Improved Modern Design



Such as Automobile Body Presses, Flanging Presses, Broaching Presses, Forcing Presses, Forming Presses, etc., etc.

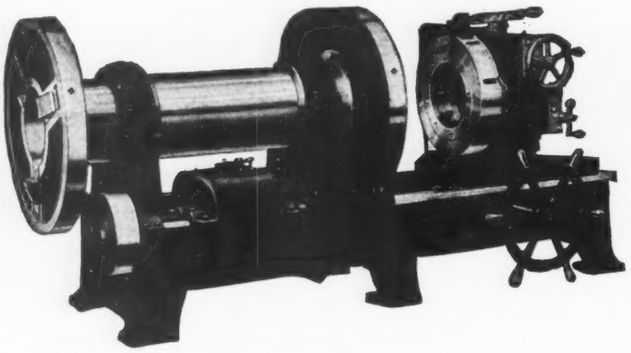


PUNCHES AND SHEARS
PLATE BENDING ROLLS
Special Machinery

SOUTHWARK
FOUNDRY AND MACHINE CO.
ESTABLISHED 1836
PHILADELPHIA, PA.

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PEERLESS B&K DUPLEX P·D·Q·C



Always on the Job

Ready for threading pipe any moment from Monday morning to Saturday night—overtime too, if needed.

Continuous satisfactory service in a machine starts in the designing. There is where every little detail is studied with a view of producing a finished machine that will stand the hard knocks. Every part will sooner or later be called upon to stand right up to hard work. The dies, the die adjusting device, the cut-off, the chucks, the oiling system, should all be dependable. B&K machines have that look of strength and bigness that you like to see in a pipe machine.

Forge ahead with a better thread. Send for a Catalog.

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PEERLESS B&K DUPLEX P·D·Q·C

Sign Up for Better and Cheaper Threads —Order a Saunders Machine

Equipment—New Type Adjustable Expanding Die Heads with Interchangeable Chasers.

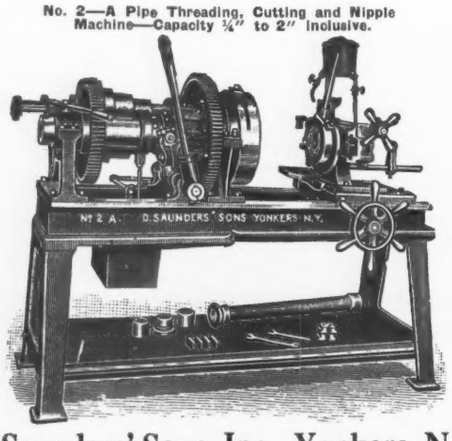
Machines for threading and cutting pipe up to 4″ equipped with Patent Lever Gripping Chucks which permit the pipe to be gripped and released without stopping the machine.

Uniform surface speed for threading all sizes of pipe is an exclusive feature of the Saunders Machine.

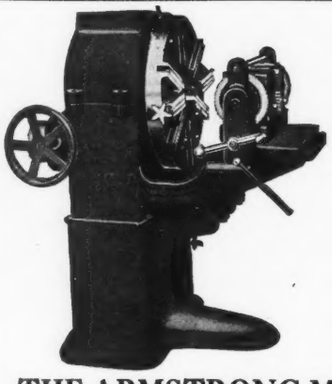
Machines for threading and cutting pipe up to 18″ inclusive.

Write for Catalogue "P"

No. 2—A Pipe Threading, Cutting and Nipple Machine—Capacity ¼″ to 2″ inclusive.



D. Saunders' Sons, Inc., Yonkers, N.Y.



ARMSTRONG No. 3 Pipe Threading Machine

POWER ONLY

Threads Pipe 1 inch to 6 inches right or left.

MANUFACTURED BY

THE ARMSTRONG MFG. COMPANY

BRIDGEPORT, CONN.

MERRELL Pipe Threading and Cutting Machinery

Hand or Power Operated

THE MERRELL MFG. COMPANY

15 Curtis Street TOLEDO, OHIO

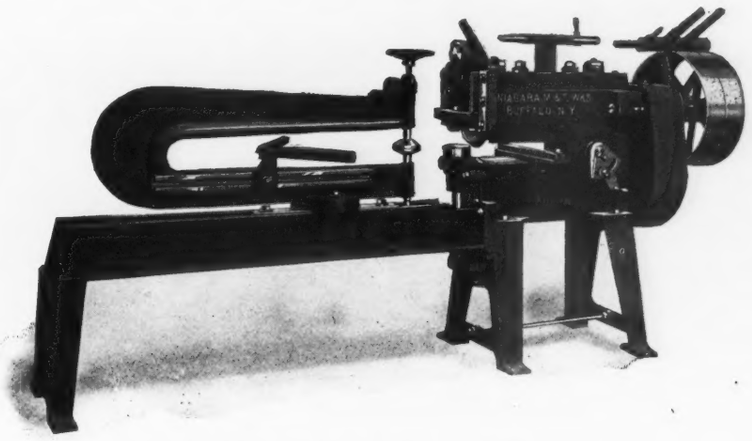
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Efficient, profitable, *Modern* machines for the stock room. Capacity to 10″ stock. Circular.

Note—We also make high grade broaches for all purposes.

Hurlbut, Rogers Machinery Company

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No. 208A Circle Shear and Flanger

Circle Shears With Flanging Attachments

will cut and turn flanges of exceptional height and neatness.

We manufacture a complete line of Presses, Punches, Squaring Shears, Ring and Circle Shears, Tinners' Tools and Machines, as well as equipments for special operations on Sheet Metal.

Write for catalog of the machines in which you are interested.

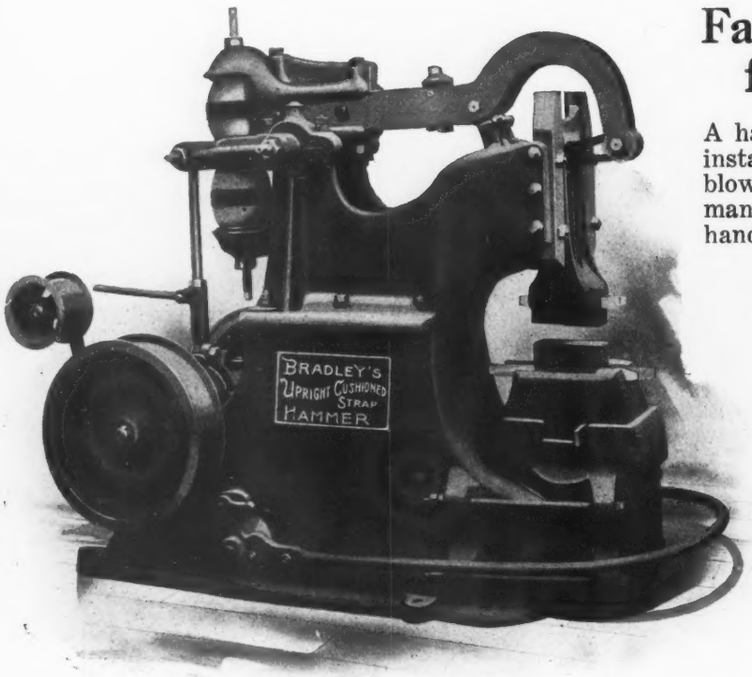
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Established 1879

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NIAGARA

The Bradley Strap Hammer



Fast and Economical—for General Jobbing

A hammer that can be started and stopped instantly, that strikes hard, quick, springing blows and is under instant control—a one-man hammer, unless the work is too big to handle to advantage.

Railway, machine and repair shops find this machine invaluable for tool dressing, drawing, welding and repair work, for finishing drop forgings, edging up parts made from flat metal and for forming small pieces such as stay-bolts, brake rods, levers, ball bearings, hinge pins, etc. Let us tell you more about it.

We also build Upright and Cushion Helves and Compact Hammers.

Circulars on request.

C. C. Bradley & Son, Inc.
Syracuse New York, U.S.A.
ESTABLISHED 1832

POWER

If it's a NAZEL AIR HAMMER

You are sure of more power than it is possible to obtain with a spring hammer, more economy than it is possible to obtain with a steam hammer and greater efficiency than with either.

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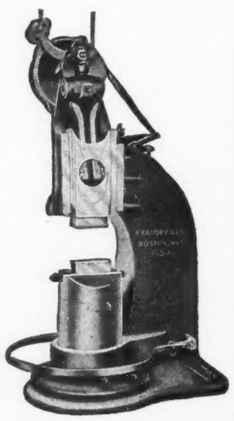
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A Paying Investment if used but an hour a day. 50 to 500 lbs.

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All Sizes for Every Class of Forging Work
HYDRAULIC MACHINERY
CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.
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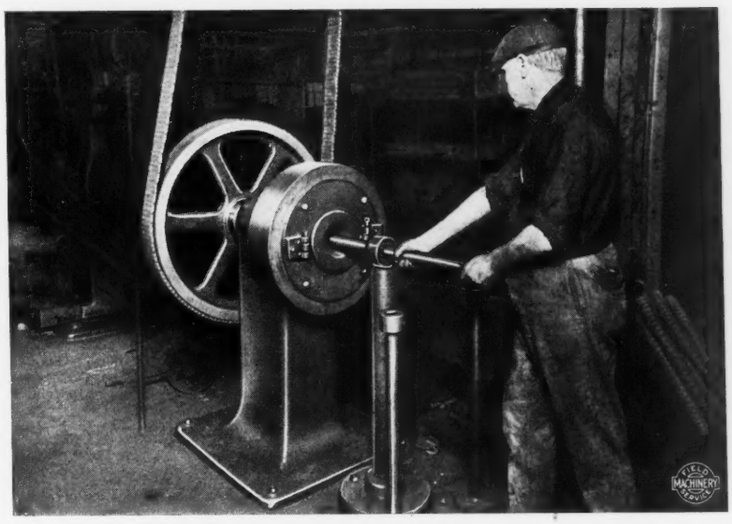
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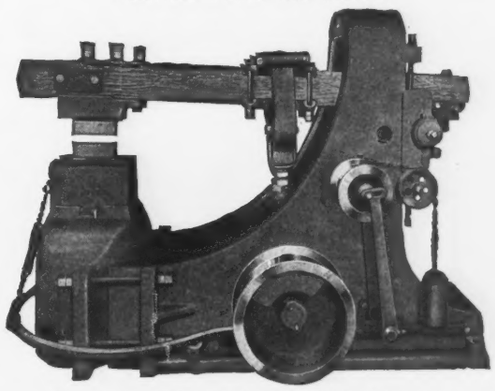
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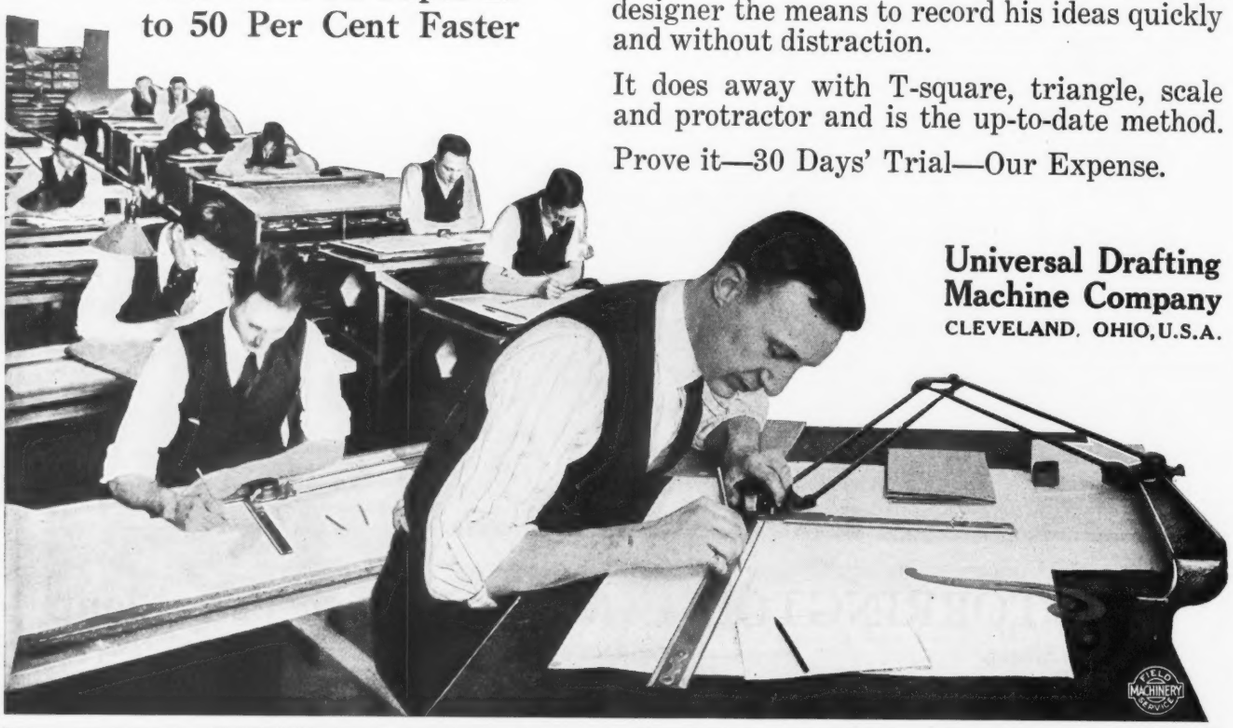
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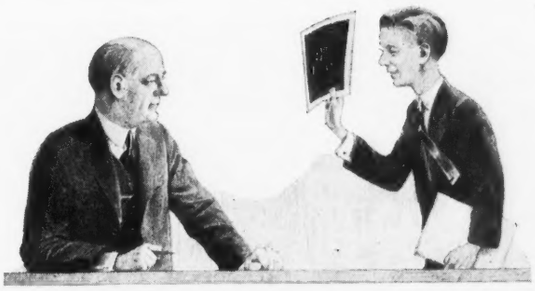
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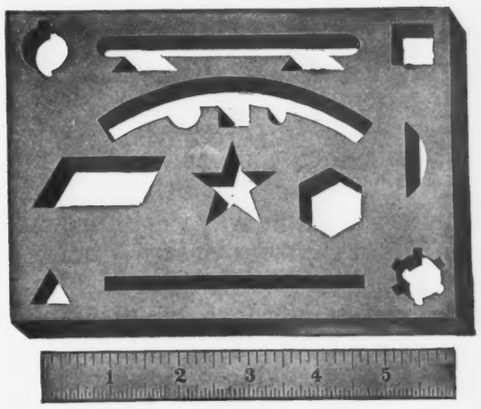
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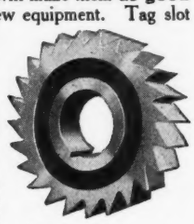
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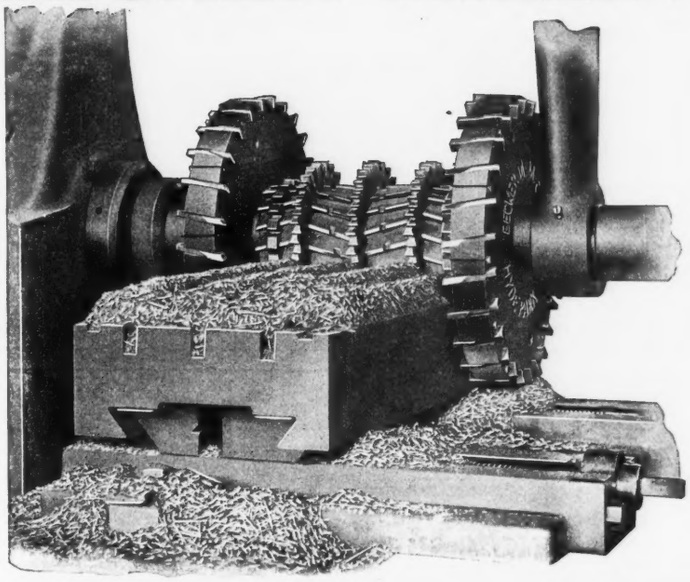
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Send for a stock list. Let us give estimates on the special tools you need.

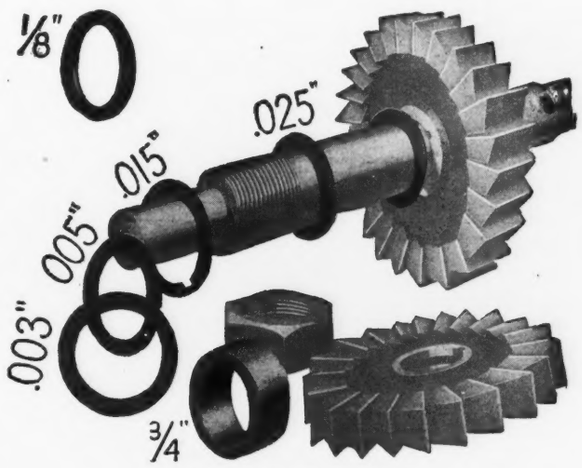
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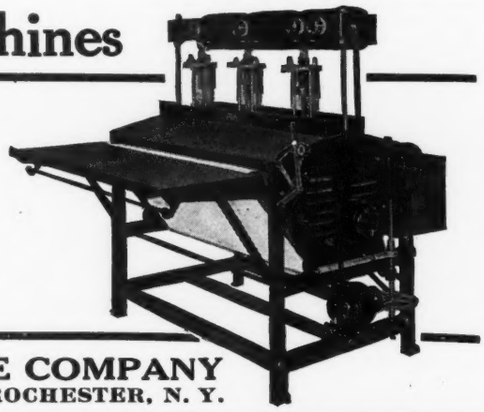
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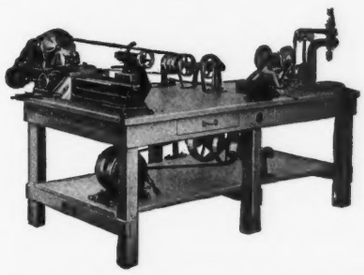
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Piecework Lags too without Counters

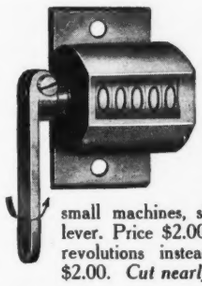
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You measure or count the output with a Veeder Counter—which indicates not only the amount actually done but the amount which **ought** to be done.

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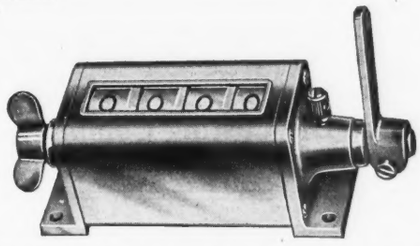
Veeder
COUNTERS

show the *should-be* production and how well the worker maintains it, hour by hour.



This small **Rotary Ratchet Counter** (No. 6) counts reciprocating movements of the lever, as required in recording the product of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price $2.00. Small *Revolution* Counter, to record revolutions instead of reciprocating movements, also $2.00. *Cut nearly full size.*

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Drop forged load bearing and strain resisting parts are vital. Machine productiveness depends upon it. By the use of Champion Drop Forgings you may achieve:

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Hundreds of different parts can be forged by Champion. You want business then you will appreciate the cooperation of a Champion Engineer—a practical business man and productive executive who will study your problem intimately with your engineers. His services are available on request. Name the time he may prove to you the soundness of these claims,

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The World's Largest Producer of

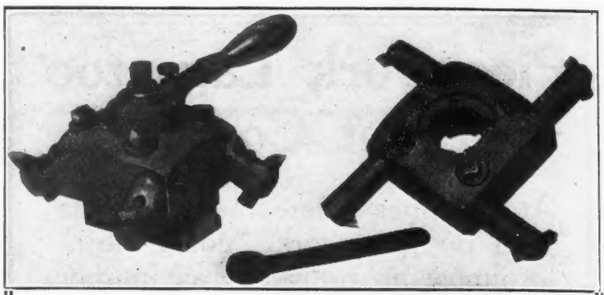
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Good die castings—any alloy you want on aluminum zinc, tin or lead base—any shape that can be cast—some shapes you may not think possible.

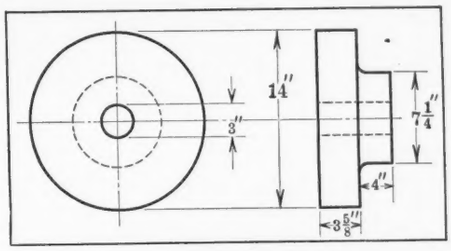
Skill, experience, excellent equipment—a plant big enough for quantity work and small enough to give all work personal attention. Write us.

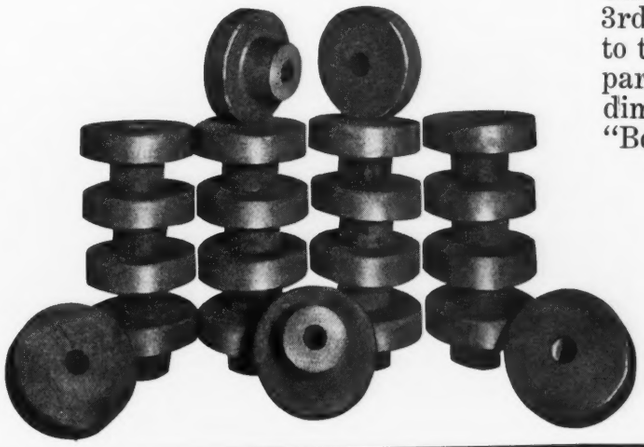
Republic Die Casting Company, Inc.
138 Mott Street New York City

STEEL In stock at **David Lupton's** Lupton INVESTMENT VALUE PHILADELPHIA SHELVING warehouse **Sons Co., Phila.**

KELLER AUTOMATIC MACHINES
CUT DIES TIME COST
KELLER MECHANICAL ENGRAVING CO.
74 WASHINGTON ST. BROOKLYN, N.Y. KMZ

Another Case Where J & J "Better Forgings" Proved Cheaper Than Castings





These 14" gear blanks average 183 lbs. each. The people for whom we forge them used to buy steel castings and rejected 10 to 20% out of every lot because blow holes developed in machining.

Changing to our forgings brought three important advantages which aggregated a considerable reduction in cost: 1st, rejections are eliminated; 2nd, the forged blanks are stronger and more durable; 3rd, machining costs are less—due partly to the elimination of machining defective parts and partly to the closeness of finish dimensions which is typical of J & J "Better Forgings."

We forge Gear Blanks, Shafts, Spindles, Weldless Rings, Arbors, Etc., to any specifications and in any quantity.

Let us estimate on your requirements.

The Johnston & Jennings Co.
Incorporated 1894
Addison Road and Lake Shore R. R. Tracks
CLEVELAND OHIO, U. S. A.

DYSON FORGED

means just one thing—the best quality at a fair price.

Our capacity enables us to handle anything from a 3" nut to a 5 ton shaft, easily and efficiently.

Get our estimates—make comparisons.

JOSEPH DYSON & SONS
CLEVELAND OHIO, U. S. A.

VULCANIZED FIBRE

BE SURE AND SPECIFY

"WILMINGTON FIBRE" SHEETS RODS TUBES WASHERS Etc. SPECIALTIES

WILMINGTON FIBRE SPECIALTY CO., Wilmington, Del.
BRANCH OFFICES "EVERYWHERE"

HOLLOW BORED FORGINGS AND STEEL SHAFTS

Lathe Spindles, Piston Rods, Hydraulic Cylinders, Rams, etc.

If hollow steel shafts are needed in your equipment it will pay to consider a proposition from us.

American Hollow Boring Co., Erie, Penna.

STANDARD GAUGE STEEL CO.

Incorporated 1892

Manufacturers of

COLD DRAWN STEEL:—
Rounds, Squares, Hexagons, Flats and Special Shapes.

MACHINE KEYS
WOODRUFF KEYS
MACHINE RACKS
ELEVATOR GUIDES
CRANK SHAFTS
CONNECTING RODS

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Beaver Falls, Penna.

Philadelphia Office, - - - 611 Harrison Bldg.
Detroit Office, - - - 505 Capital Theatre Bldg.
Chicago Office, - - - - 1240 Old Colony Bldg.

REPRESENTATIVES

P. F. McDonald & Co., - - - - Boston, Mass.
Rolph Mills & Co., - - - San Francisco, Cal.

MOLTRUP FINISHED MACHINE KEYS

The "Pass-Keys" to Real Service



Made in Standard and Special Sizes

Moltrup Finished Machine Keys are quality products; well finished, accurate, dependable; made from cold drawn steel expressly prepared for the purpose. They render real and lasting service—a service that pleases sufficiently to persuade you to come back to us again. In addition to carrying every size and style in general use, we assure you quick delivery on any *special* keys you may require. Write for particulars.

MOLTRUP STEEL PRODUCTS CO., Beaver Falls, Penna., U.S.A.

DISTRICT OFFICES: New York, Woolworth Bldg.; Boston, 201 Devonshire St.; Atlanta, Ga., 1118 Healey Bldg. **SALES AGENCIES:** Central Steel & Wire Co., Chicago and Detroit; H. D. Cushman Company, Cleveland, O.; Iroquois Steel Co., Buffalo, N. Y.; R. E. Murray & Co., 308 McKevitt Bldg., Norfolk, Va.; Union Iron & Steel Co., Cincinnati, Ohio.

SAVING A FEW CENTS PER POUND



Saving a few cents per Pound by buying babbitt which lasts only half as long as Ajax Bull Bearing Alloy, is not economy. It's sheer waste.

The babbitt itself is a minor item in the expense of re-babbitting. It's the time and production you lose while the machine is shut down. Labor costs don't stop, overhead keeps on piling up. Nothing goes down but the net profits.

AJAX BULL BEARING ALLOY

wears longer than any babbitt metal because it's made of virgin metals by the Ajax Alloying Process.

It's all in the Ajax Alloying Process.

The Ajax Metal Company

Main Office and Works: PHILADELPHIA, PA.

New York Boston Cleveland Louisville Birmingham Chicago

FERRO-URANIUM
FERRO-VANADIUM

of the Highest Quality

STANDARD ALLOYS COMPANY

Pittsburgh, Pennsylvania

HOYT

HIGH GRADE

SOLDERS



The HOYT name on solder is your assurance of quality—always order by name:

HOYT Warranted—the best
HOYT Strictly—high grade at moderate cost.

If your jobber can't supply you—write for our proposition.

HOYT METAL COMPANY

St. Louis Chicago Detroit New York



Get Expert Advice!

It usually pays. Certainly it has helped Acklin customers get the best results in the production of stamped parts in all metals.

Acklin Stamping experts plan the methods, direct the work, approve the results. That is why Acklin Stampings are invariably satisfactory and economical.

Get expert advice on your stamping problems

THE ACKLIN STAMPING COMPANY

1657 Dorr Street **Toledo, Ohio**

THE MOHEGAN TUBE COMPANY

Hot and Cold Rolled
STEEL TUBING

Seamless Welded Butted
Open Seam Lock Joint

Ready for Immediate Use

We carry a large stock of round, square, rectangular and other standard shapes; and are prepared to supply specials to specifications.

Our Cold Drawn Tubes have a high lustre, well liked for fine surface finishes.

Try non-corrosive tubing of Pure Nickel and Monel Metal; and Tinned and Galvanized Tubes for all mechanical purposes. They cut out frequent replacements and improve the product.

Circulars on Request.

THE MOHEGAN TUBE COMPANY

308 SCOTT AVE. BROOKLYN, N. Y.

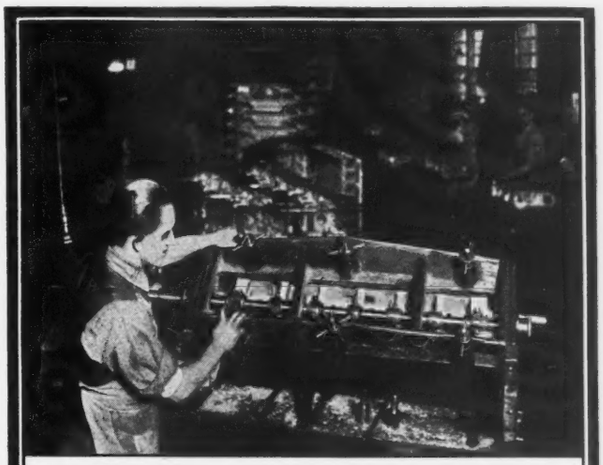
SuperCast Quality
The Best there is in Die Casting

Dependable SUPER CAST Die Castings

The Superior Die Casting Company
CLEVELAND

DIE CASTINGS
Prompt delivery guaranteed. Send samples, blueprints or sketches for estimates.
MT. VERNON DIE CASTING CORPORATION
MOUNT VERNON, N. Y.

EC
ELECTRIC
STEEL CASTINGS
Farrell-Cheek Steel Foundry Co.
SANDUSKY, OHIO



FRANKLIN
DIE-CASTINGS

Best for Bearings

Not only in automobiles, but also in stationary engines, compressors, automatic pumps, etc., Franklin Die-Cast bearings represent a big advance over the old method of babbitting the shaft.

They give better service than machined bearings, being equally accurate, more uniform, quicker to interchange (no metal to pour) and harder (chilled under pressure).

They lower costs in assembly, upkeep and replacement. They require no machine operations save those customary in assembling even the most fully machined bearings—line-reaming, scraping, burnishing, etc.

The babbitts used include the S. A. E. standard formulas, together with others proved by Franklin's 30 years of experience.

Let us solve your problems. We quote from samples or blueprints. Send for booklet: "Franklin Die-Castings in Modern Inventions."

FRANKLIN DIE-CASTING CORPORATION
Gifford and Magnolia Streets Syracuse, N. Y.



"THE HOUSE OF HAWKRIDGE"



The use of Hawkridge Steel for all purposes for which high grade steels are essential has become so general in this part of the country during the past 38 years that it is fast assuming the dignity of a habit among New England steel users. "Cooperation" is our motto; and watchmakers, spring makers, small tool makers, hospitals, electrical supply houses, machine tool builders, quarries, mines, cutlery companies and many others have benefited at one time or another by our far-sighted selling policy, which gives the salesman as much credit for advancing the interests of a customer as for selling a car load of Hawkridge Steel.



Our line is complete and includes the Best High Speed Steel made, the freest cutting Machinery Steel, Crucible Tool Steel (including the "Hawk" Brand). Oil-hardening or Water-hardening, Hot-rolled or Cold-drawn, High Carbon or Low Carbon, Rough-turned or Drill Rod finish, Heat-treated or Annealed, Alloyed or just plain Steel—in Rounds, Squares, Hexagons, Octagons, Quarter Octagons and Special Shapes.

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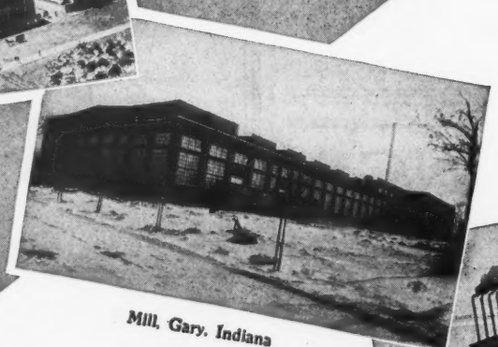
UNION DRAWN SERVICE

Bright Finished Steel

Quality, Variety, and Delivery Unexcelled



Main Mill, Beaver Falls, Pa.



Mill, Gary, Indiana



Mill No 2, Beaver Falls, Pa.

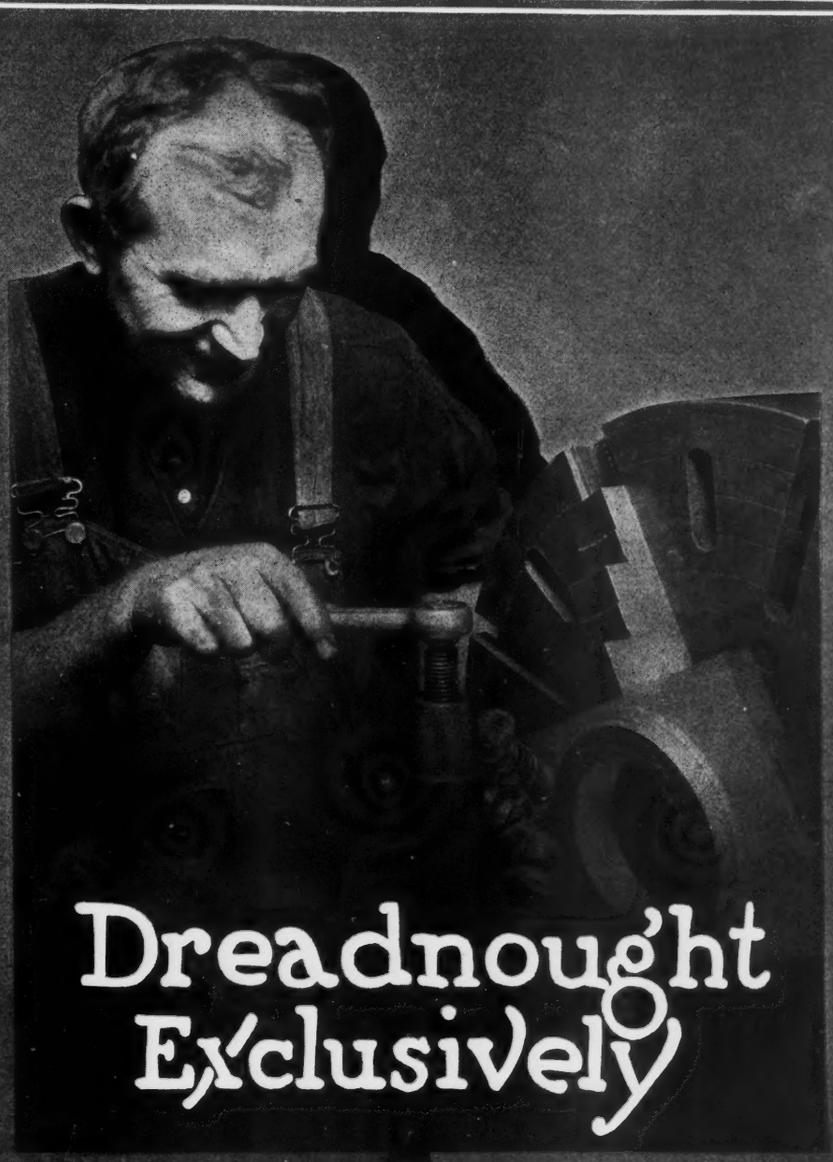
WE specialize in Cold Drawn, Turned and Polished Shafting and Elevator Guides, Free Cutting Screw Stock, Squares, Flats, Hexagons and Special Cold Drawn Shapes—Best Bright Bessemer, O. H. Alloy and Electric Steels.

Write for Quotations.

Union Drawn Steel Co. Main Office: **Beaver Falls, Pa.**

WORKS: Beaver Falls, Pa. and Gary, Ind.

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The best that experience, science and skill can produce—that's Dreadnought High-Speed Steel. On these three counts Dreadnought tools won their name; long life between grinds—resistance to friction—ability to withstand heat.

Tried, tested and found not wanting; that's why many of the largest metal working plants adopted and standardized Dreadnought. For tools Dreadnought is supreme. Remember the name when next you are ready to order.

Our Free Booklet describing the various brands of Halcomb Steels will interest you. Ask for a copy.

HALCOMB STEEL CO., Syracuse, N.Y., U.S.A.

Branches: **New York City, Philadelphia, Chicago, Cleveland, Detroit and Boston**

TOOL STEELS

Blue Chip

High Speed

and other

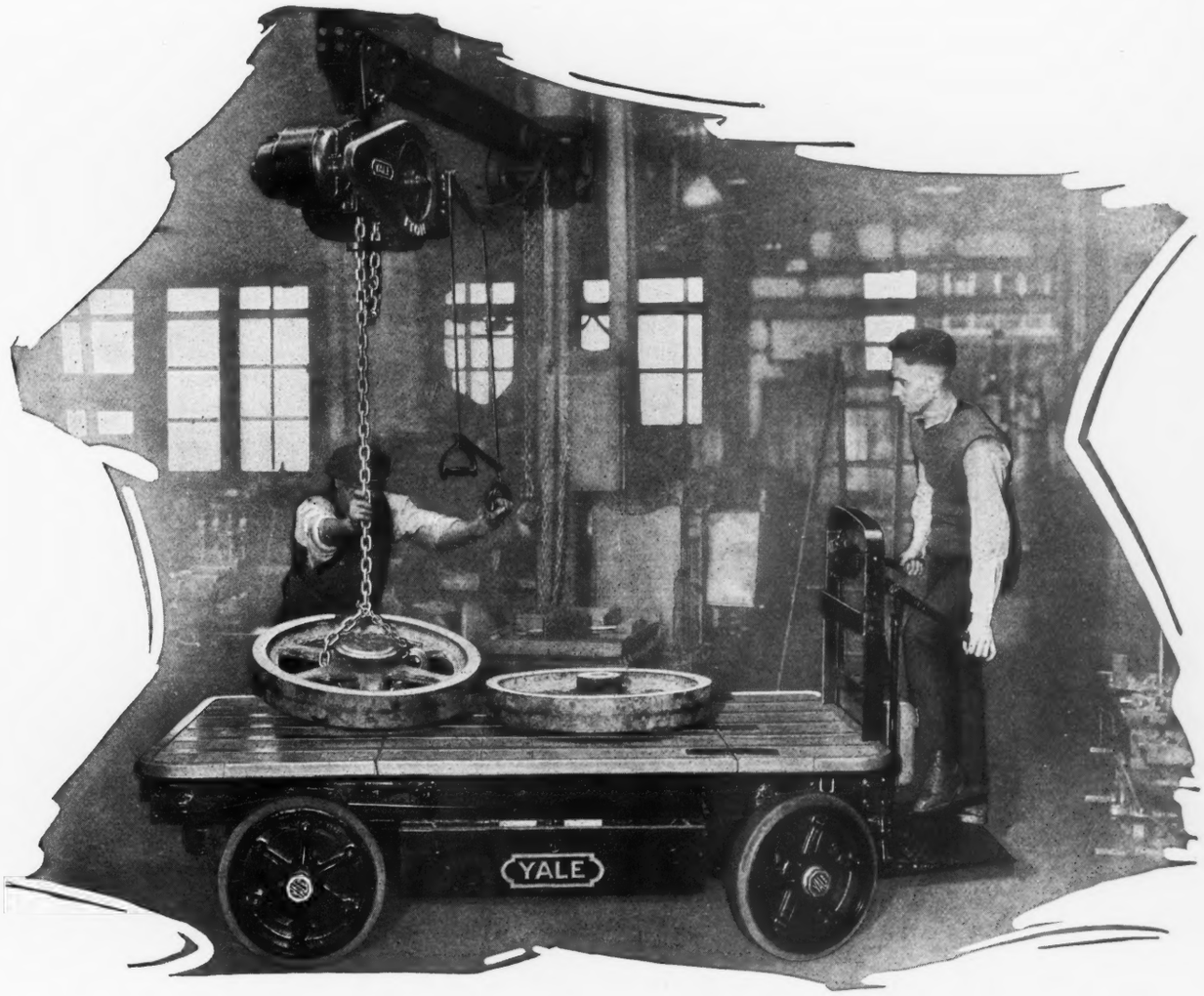
FIRTH-STERLING TOOL STEELS

THE knowledge, experience and skill of SHEFFIELD combined with the best PITTSBURGH practice have made these steels the standards of QUALITY and UNIFORMITY wherever Tools are used

FIRTH-STERLING
STEEL COMPANY

McKeesport, Pa.

NEW YORK BOSTON HARTFORD
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A speedier, better plant; with Yale Methods

The Yale Methods of handling parts and materials in process mean fewer machines for the same output or, what is better, greater output for the same money.

Handling costs, depending on the product you are making or the industry in which you are engaged, range from 10% to 90% of the total cost of production.

Your plant equipped with Yale Electric Industrial Trucks and Yale Electric Hoists will be a speedier, better plant because you will have cut down one of the heaviest items of manufacturing expense.

Yale Material Handling Equipment includes Yale Electric Hoists, Yale Electric Industrial Trucks, Tractors and Trailers, Yale Spur Geared, Screw Geared and Differential Chain Blocks and Yale I-Beam Trolley Systems.

Investigate the Yale Methods. Find out what they will do for you. Our engineers are at your service.

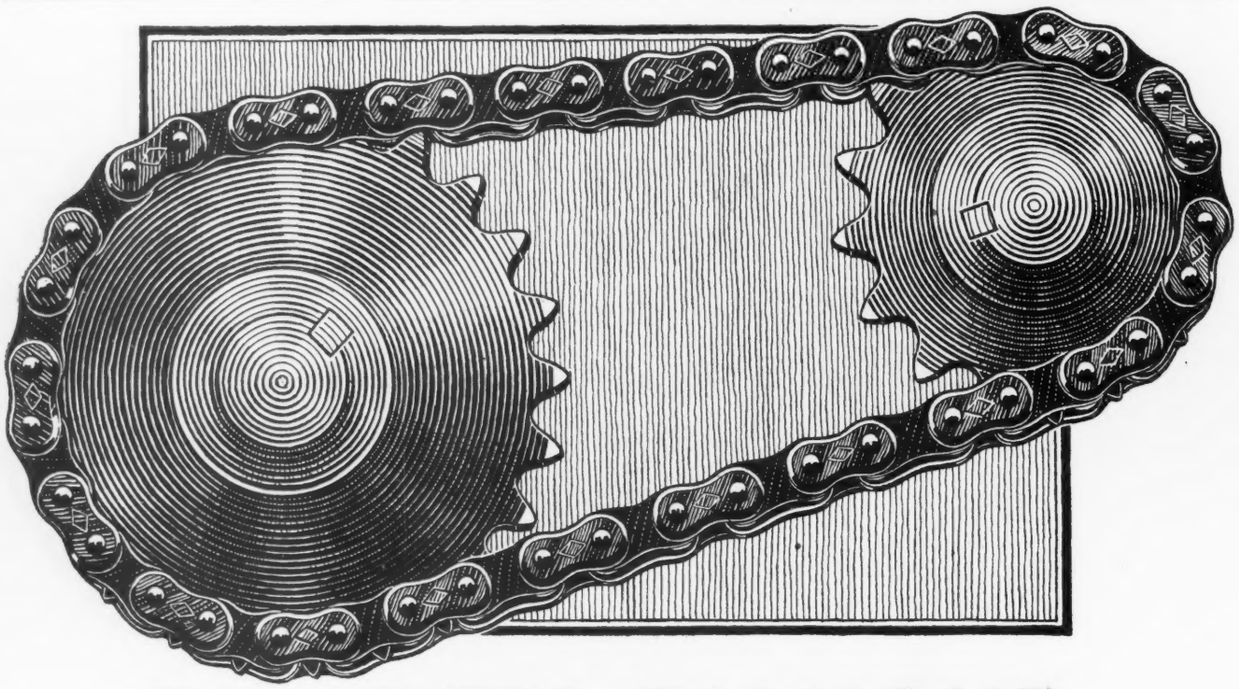
Yale Made is Yale Marked

The Yale & Towne Mfg. Co.

Makers of Yale Products:
Locks, Door Closers, Hoists and Electric Industrial Trucks

Stamford, Conn., U. S. A.

TRADE YALE MARK **Hoisting and Conveying Systems**



Drive It With DIAMOND Chains and Sprockets

For practically every place where power is transmitted—whether on a light, high speed electrical device, or on a heavy, slow speed machine tool — DIAMOND Chains and Sprockets provide dependable power-drives that meet every demand of efficiency and economy. They save power, and speed up machinery, because slippage is eliminated and friction reduced. They avoid shutdowns and save repair bills by giving constant, durable service.

They are extensively used by mills, mines, factories, power plants, railroads, etc.—daily demonstrating their ability to reduce costs of power and maintenance, and increase the output of machines they serve.

In the DIAMOND Line are more than fifty standard chain models—ranging from $\frac{3}{8}$ to 2 inches in pitch, and from $\frac{1}{8}$ to $1\frac{1}{4}$ inches in width. This offers you correct chains for all transmission requirements, no matter how high the speed or how heavy the load.

And whatever size or type of sprockets you require, the DIAMOND Sprocket department is well equipped to serve you. Where special chains are required, we can produce standard roller or block chains with special features to meet your needs.

To aid you in selecting the chain and sprockets best suited to your drives, we offer the services of our engineers, who have had years of specialized experience in solving transmission problems.

We have a handy-size, loose-leaf book "Useful Data on DIAMOND Chain Drives." You'll find it of real help in ordering DIAMOND Chains and Sprockets. Write for it.

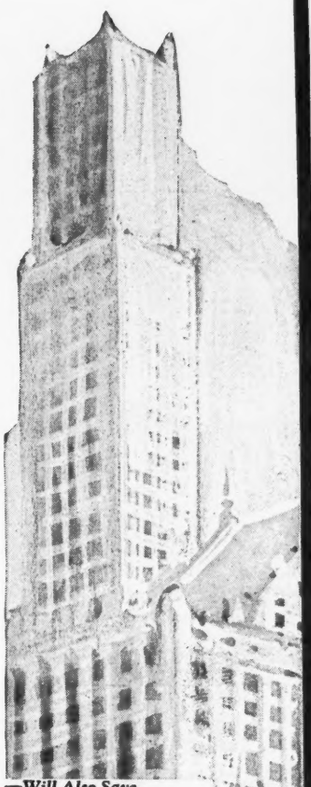
DIAMOND CHAIN & MFG. COMPANY, Indianapolis, U. S. A.

Makers of High Grade Chains and Sprockets Since 1890

DIAMOND

CHAINS ◇ SPROCKETS

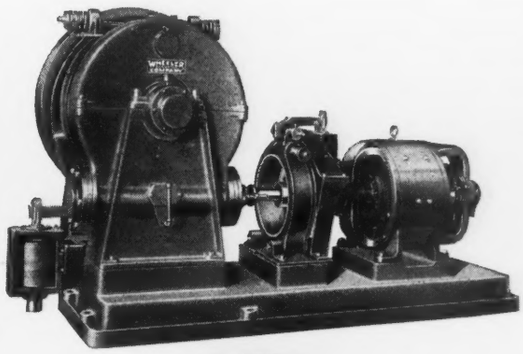
TRADE MARK

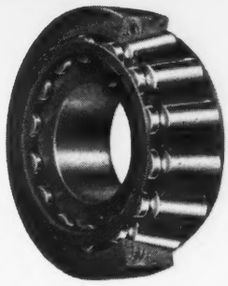


—*Will Also Save Power and Money in*—

Blowers and Compressors
Clay Working Machinery
Cranes
Dairy Equipment
Electric Motors
Electrical Machinery
Elevator Drives
Farm Lighting Units
Gasoline Rail Cars
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Grain Milling Machinery
Grinders
Hoisting and Conveying Machinery
Industrial Tractors and Trucks
Laundry Machinery
Lawn Mowers
Machine Tools
Mine Cars
Mining Machinery
Oil Well Machinery
Paper Making Machinery
Power Transmission Machinery
Printing Presses
Pumps
Railway Equipment
Refrigerating Machinery
Road Making Machinery Wheel
Separating Machinery
Shoe Machinery
Steel Mill and Foundry Equipment
Stokers
Street Railway Cars
Street Sweepers
Textile Machinery
Tire Making Machinery
Ventilating Machinery
Wood Working Machinery

—*and Wherever There Is Friction*



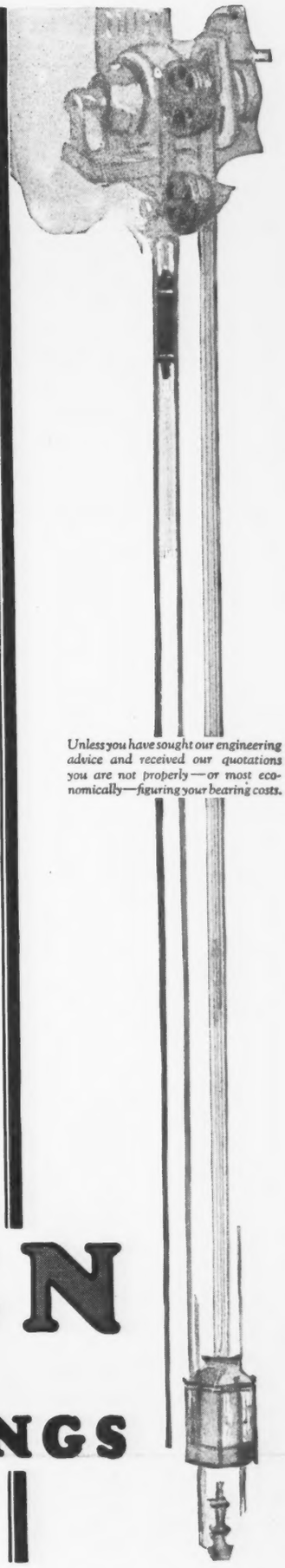


Entire Line Is Timken-Equipped

As an indication of extreme confidence in The Timken Roller Bearing Company and its product, we present below, a paragraph from a letter by President C. W. Wheeler, of the Wheeler Elevator Company, addressed to The Timken Roller Bearing Company—

"It is a pleasure to note that you so heartily approve of our arrangements for the application of your bearings to our elevator machines. During the past three years, we have demonstrated to our satisfaction the practicability of the use of these bearings in the machines we have been building. So sure are we that this is the bearing to use, that we have actually gotten out an entire new line of machines using your bearing."

The Timken Roller Bearing Co
CANTON, OHIO



Unless you have sought our engineering advice and received our quotations you are not properly—or most economically—figuring your bearing costs.

TIMKEN
Tapered
ROLLER BEARINGS

LINK-BELT "PROOF TESTED" ROLLER CHAIN





THE Transmission of Power through roller chain drives is gaining in popularity as an effective, yet economical, method of driving machinery.

Link-Belt Roller Chain represents the highest development of chains of this type. Every foot is proved for physical strength and wearing value.

Link-Belt Roller Chain is made to the high standard maintained for the entire Link-Belt Line. Every link bears our trade mark >——< and is fully guaranteed.

Send for Data Book No. 257.

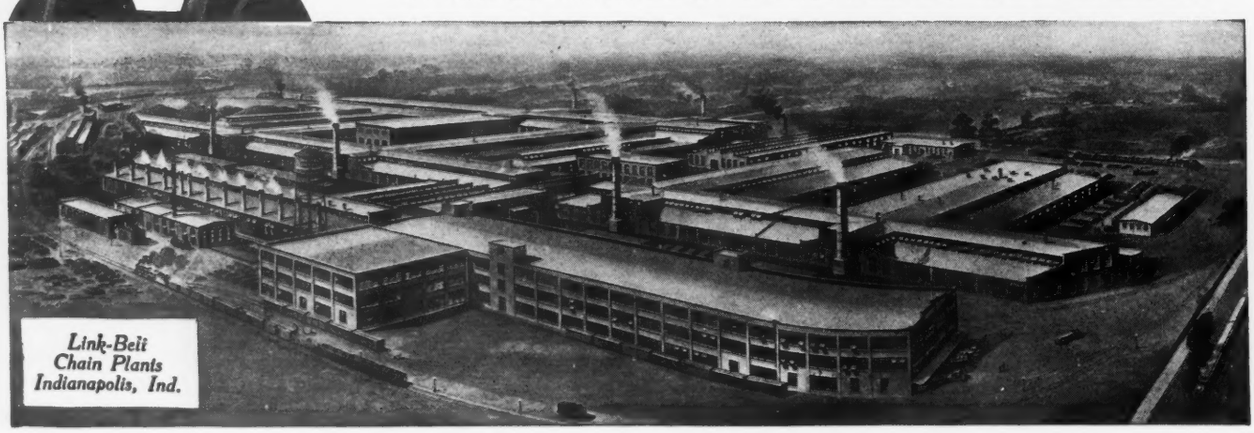
719

LINK-BELT COMPANY

World's Largest Manufacturers of Conveying and Power Transmission Chains

PHILADELPHIA		CHICAGO		INDIANAPOLIS	
New York	Woolworth Bldg.	Seattle	820 First Ave., S.		
Boston 9	49 Federal St.	Portland, Ore.	101 First St.		
Pittsburgh	1501 Park Bldg.	San Francisco	168 Second St.		
St. Louis	Central National Bank Bldg.	Los Angeles	163 N. Los Angeles St.		
Buffalo	547 Ellicott Square	Denver	Lindrooth, Shubart & Co., Boston Bldg.		
Wilkes-Barre	2nd National Bank Bldg.	Louisville, Ky.	Frederick Wehle, Starks Bldg.		
Huntington, W. Va.	Robson-Prichard Bldg.	New Orleans	C. O. Hinz, 504 Carondelet Bldg.		
Cleveland	429 Kirby Bldg.	Birmingham, Ala.	S. L. Morrow, 720 Brown-Marx Bldg.		
Detroit	4210 Woodward Ave.	Charlotte, N. C.	J. S. Cothran, Com'l Bank Bldg.		
Kansas City, Mo.	306 Elmhurst Bldg.	Canadian Link-Belt Co., Ltd.,	Toronto and Montreal		

H. W. CALDWELL & SON CO., CHICAGO NEW YORK, Woolworth Bldg. DALLAS, TEXAS, 709 Main St.



Link-Belt Chain Plants Indianapolis, Ind.



T·B·WOOD SONS CO.



BY INVITATION MEMBER OF

NEW YORK, U.S.A.

In the Final Analysis——Cast-Iron Pulleys

Have you ever thought of the pulley troubles you have had and how invariably the drive was made satisfactory by installing Cast-Iron pulleys—either supplanting pulleys of some other type or by changing to cast-iron pulleys of suitable construction?

BUT IT WAS A CAST-IRON PULLEY THAT FINALLY STOOD UP UNDER THE SERVICE

Almost every user of power has had this experience and always the solution of continuously satisfactory transmission service has been the installation of cast-iron pulleys.

The use of cast-iron pulleys in the initial installation will prevent trouble.

T. B. WOOD'S SONS CO., Chambersburg, Penna.

POWER TRANSMITTING MACHINERY

AMERICAN STEEL SPLIT PULLEYS



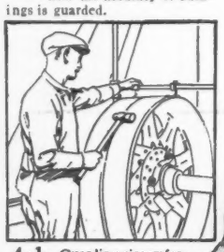
1st Careful laboratory work watches the fitness of the steel itself.



2d The micrometer faithfully guards the uniform correctness of jigs, dies and tools.



3d This test picture shows how the accuracy of bushings is guarded.



4th Guarding circumferential accuracy. Lasting trueness is assured by a series of such tests.

Uniformity of Service

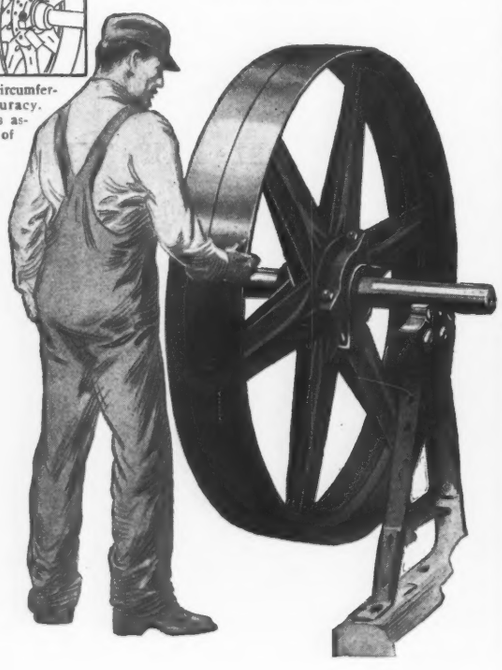
THIS essential condition of pulley efficiency is safeguarded by a long series of scientific and practical tests in the manufacturing process of "American" Pulleys. These tests make certain that each "American" Pulley is as true and perfect as every other "American."

And, in turn, this assured uniformity must be one of the major reasons why nearly six million "American" Pulleys are now in operation, both here and abroad.

A book entitled "Getting Maximum Pulley Efficiency" will be mailed you on request, at once.

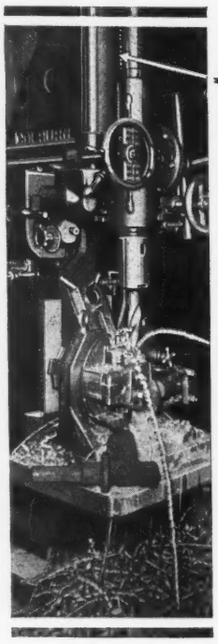
The American Pulley Co.
Philadelphia, Pa.

Manufacturers of Steel Split Transmission Pulleys, Steel Sash Pulleys and Pressed Steel Shapes



For complete list of distributors see MacRae's Blue Book

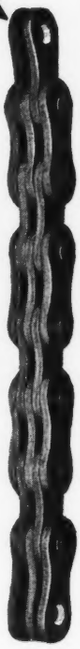
MORTON'S CHAINS
for Machine Equipment



See that Chain?

It's a "Morton"! It carries the counterweight on the Colburn Heavy Duty Radial; a "Morton" Chain is used in the same way on the Natco Drill; likewise on the swing arm countershaft of the Pratt & Whitney Automatic Profile and Cam Cutting Machine.

And so on down the line of representative machine tools, you'll find a big percentage of them carrying Morton's Chains — for counterweight or sprocket.



Write to Dept. 6 for quotations on your needs.

THOMAS MORTON
245 Centre St. NEW YORK

STEEL BEARING BALLS

BRASS AND BRONZE BALLS



STEEL BURNISHING BALLS

ASK FOR PRICE LIST 104

THE ABBOTT BALL CO.
ELMWOOD HARTFORD, CONN.

CABLE CHAINS
MADE IN EIGHT DIFFERENT SIZES.

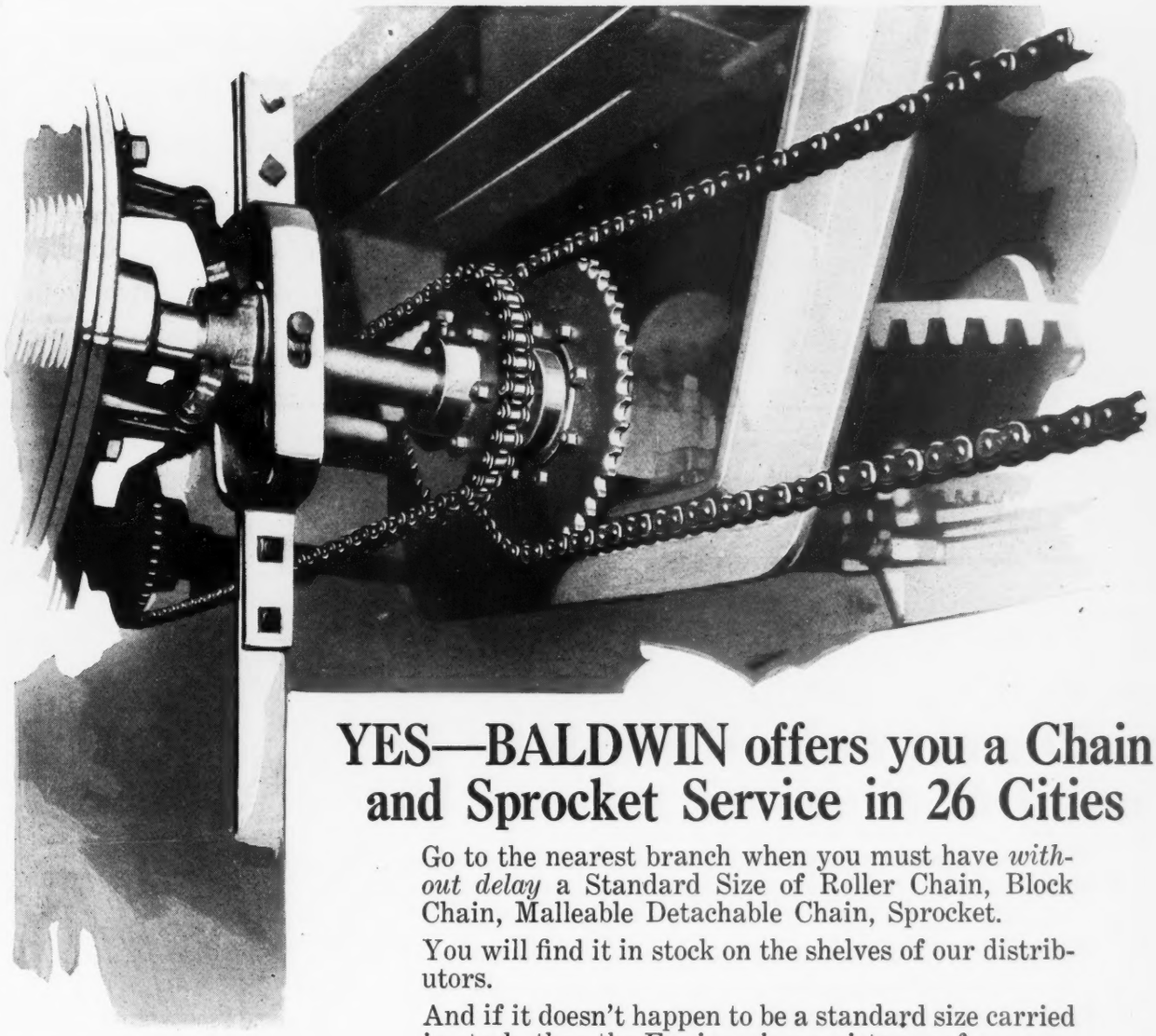


No. 30 CABLE CHAIN



NO. 50 CABLE CHAIN

THE SMITH & EGGE MFG. CO.
BRIDGEPORT, CONN.



YES—BALDWIN offers you a Chain and Sprocket Service in 26 Cities

Go to the nearest branch when you must have *without delay* a Standard Size of Roller Chain, Block Chain, Malleable Detachable Chain, Sprocket.

You will find it in stock on the shelves of our distributors.

And if it doesn't happen to be a standard size carried in stock, then the Engineering assistance of our representative will assist you in selecting the correct Special Drive or Adaptation from the Baldwin factory.

Steel Roller Chains
Steel Block Chains
Special Chains
Malleable Detachable Chains
Steel Cut Sprockets
Cast Sprockets

GENUINE BALDWIN CHAINS

BALDWIN CHAIN & MANUFACTURING COMPANY
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Baldwin Service Co.,
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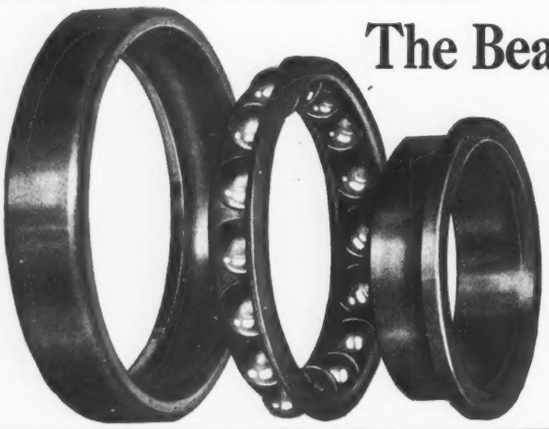
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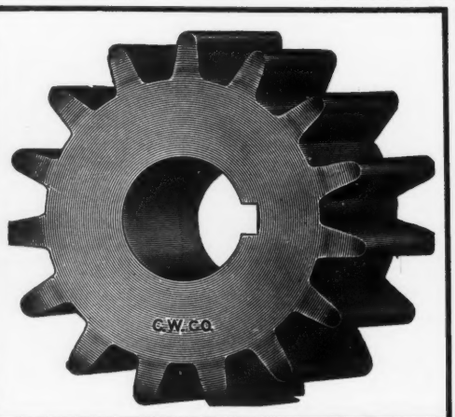
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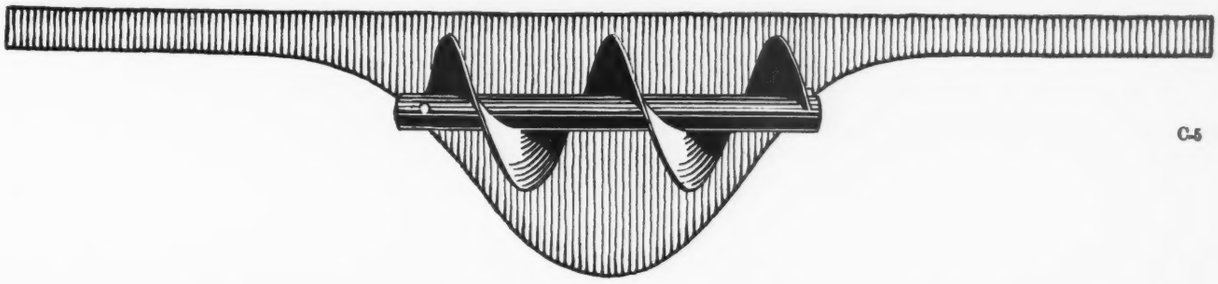
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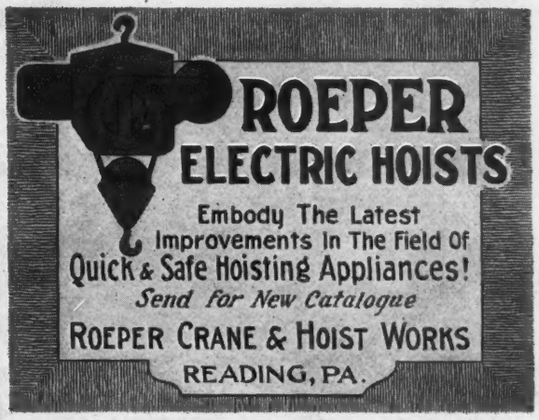
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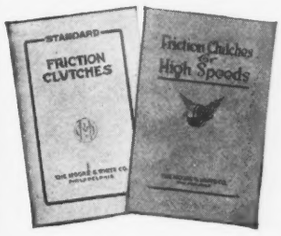
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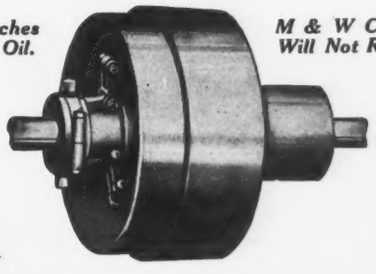
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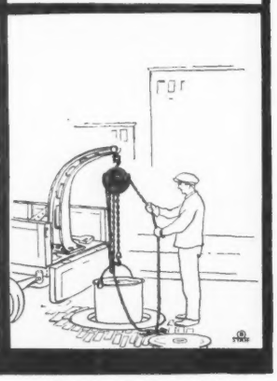
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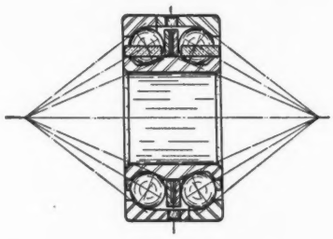


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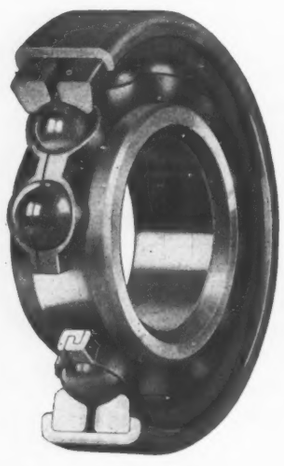
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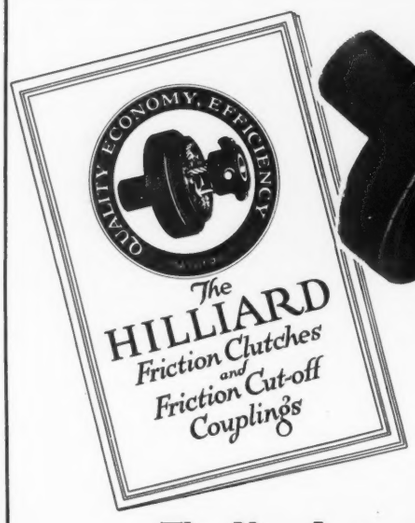
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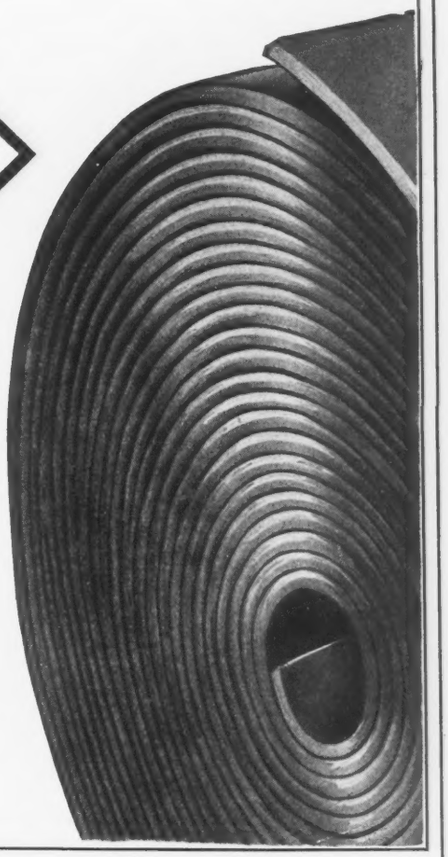
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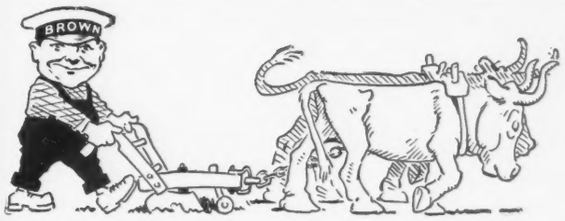
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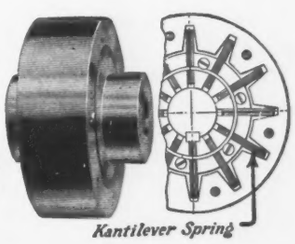


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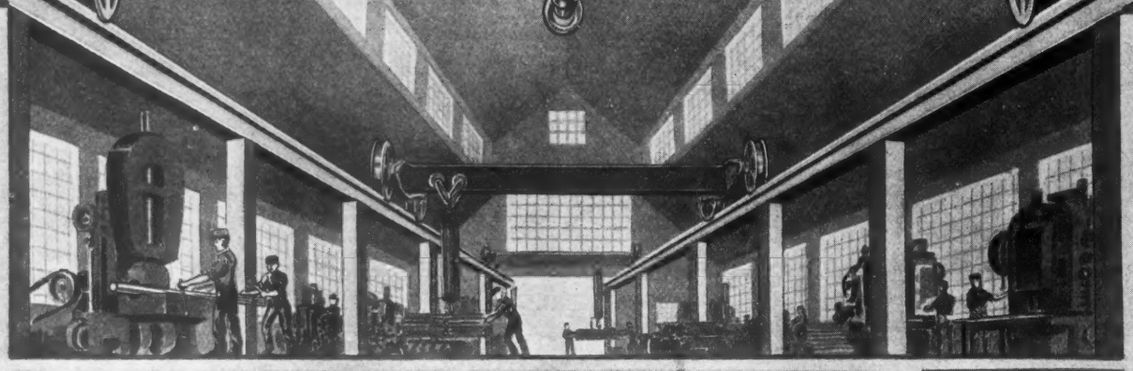
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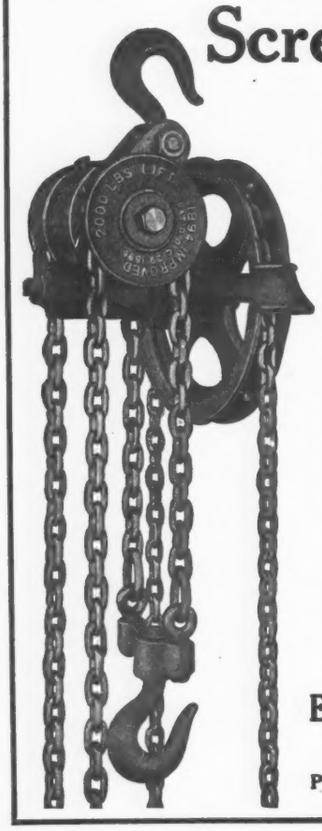
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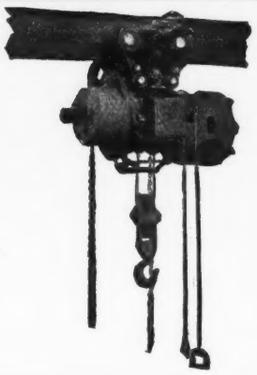
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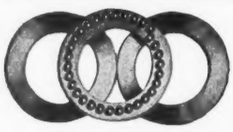


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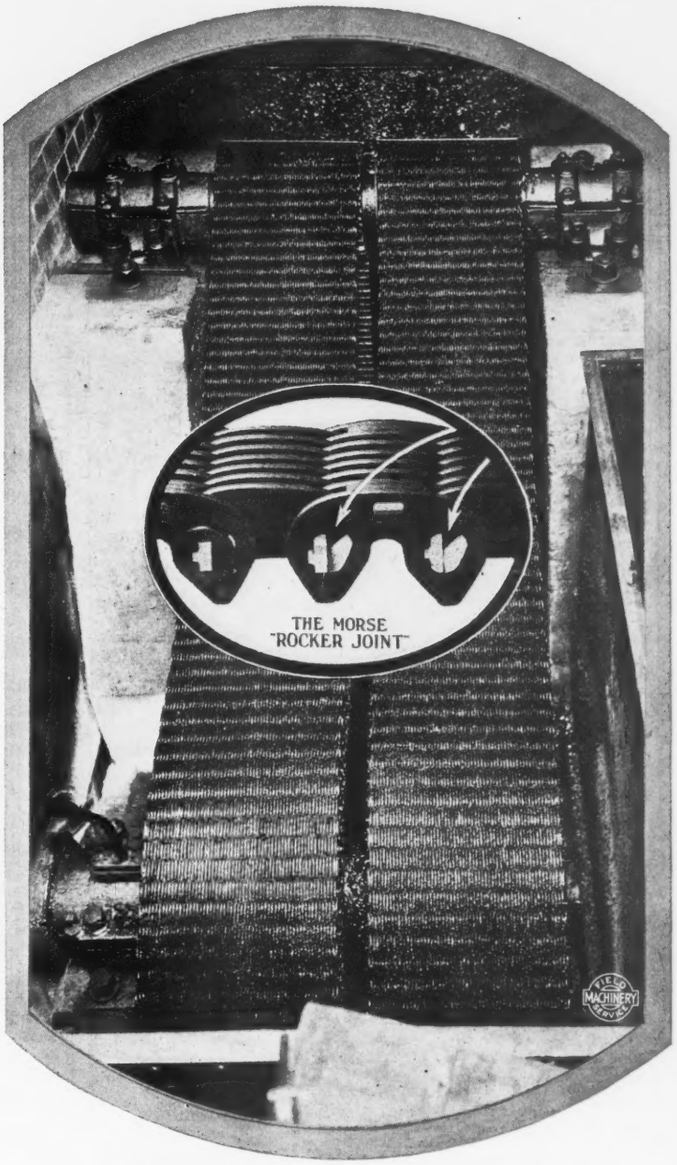
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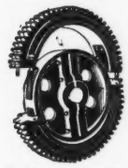


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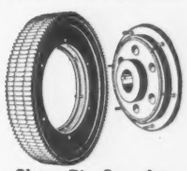
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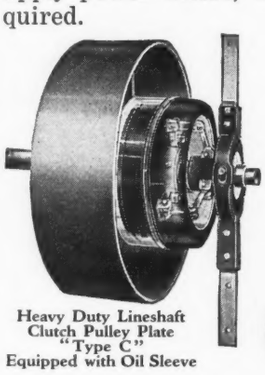
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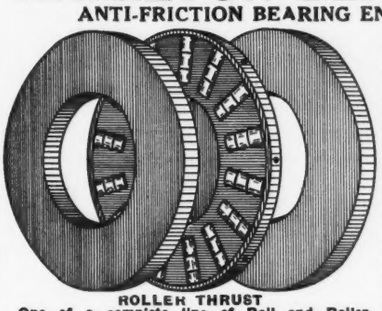
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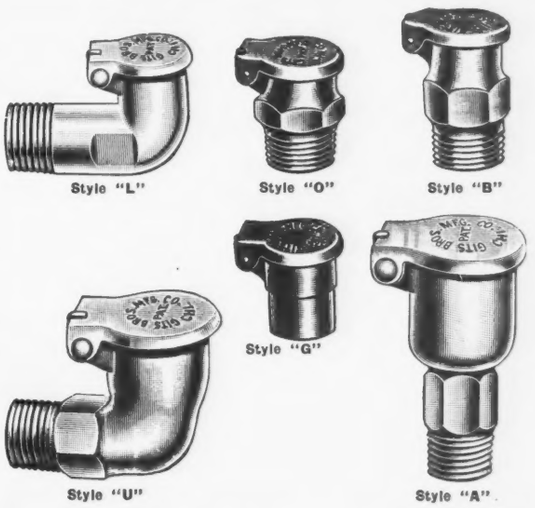
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Cut Gears, Racks, Worms, Worm Gears, Special Machinery

Write

THE SIMONDS MFG. CO., Pittsburgh, Pa.

Adams-Farwell GEAR HOBBERS

Write for Catalog No. 809

THE ADAMS COMPANY 1910 Market Street Dubuque, Iowa, U. S. A.



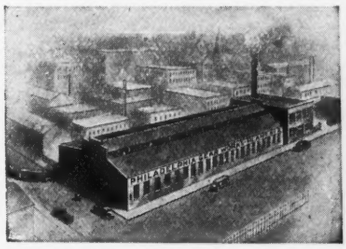
ALBRO-CLEM HINDLEY GEARING

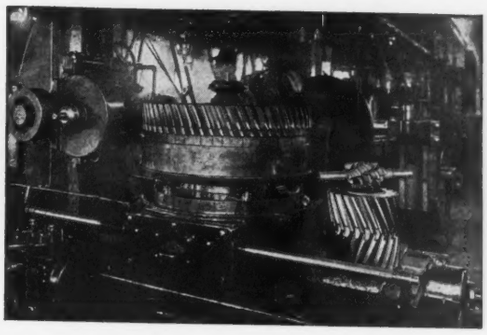
WILL DO THE WORK

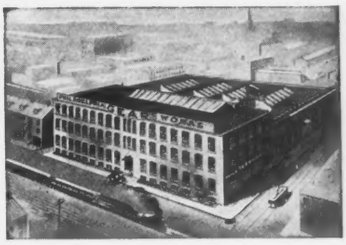
When Common Worm Gearing Fails

ALBRO-CLEM ELEVATOR CO.

500 Erie Ave., East, Philadelphia, Pa.







PHILADELPHIA GEARS

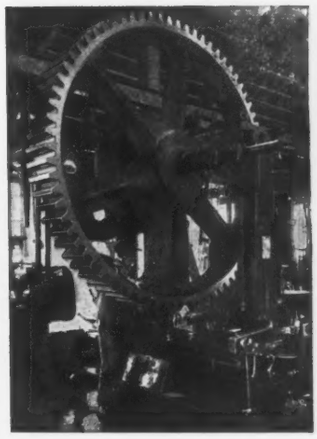
PHILADELPHIA GEAR *TIME*



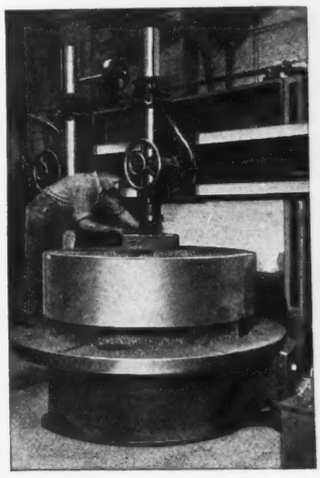
"Every Second Counts"

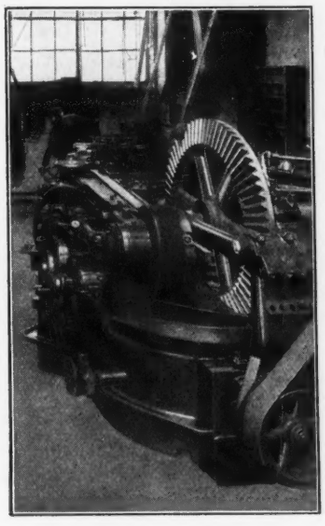
Take a look at the bird's-eye views of Phillie Gear's whole plant, and remember that the business was started only 30 years ago—the first exclusive gear making plant in the country—and has attained its present proportions solely on the merits of the service it provides.

Doesn't it indicate that this service is truly essential? And well appreciated? Doesn't it suggest that it would be a good thing for *you* also to send your gear orders to Phillie Gear?



**Bevel, Spur,
Mitre, Helical,
Spiral, Herringbone,
Worms, Wheels,
Racks, Etc.
Pinions to
Mill Gears—
any size and
in any quantity.**





Phillie Gear's Catalog is a Regular Treatise on Gears—Yours for the asking.

"Speed" is Phillie Gear's middle name; but he doesn't use it in business, for fear of misleading people who do not know that "accuracy" heads the list of "musts" in his shop.

His fondness for speed shows itself in the absence of red tape, in the accessible arrangement of his enormous stock of "ready to ship" gears and in the care with which he schedules the work so that every man and machine make "every second count."

Philadelphia GEAR Works 1120-1128 Vine St. Philadelphia

MEMBER OF AGMA

"Peerless" Rawhide Gears and Pinions

Our Specialty for the Past 30 Years



We also manufacture metal gears ¾ inch to 12 feet.

Rawhide gears and pinions are ideal where extremely high speeds demand a positive, silent drive.

"Peerless" Rawhide gears and pinions are more than ordinarily durable and elastic because our method of curing the hides retains all the original fiber, and the long period of seasoning to which we submit the blanks before cutting eliminates shrinking and distortion in service. Try them and see for yourself. Specify number of teeth, pitch or outside diameter, face overall, bore and keyseat—we'll do the rest.

Discriminating buyers agree that our product, service and prices are right.

MEMBER OF AGMA

THE HORSBURGH & SCOTT CO.

CLEVELAND, OHIO, U. S. A.

MEACHEM

INDUSTRIAL GEARS ONLY

A Gear Service

geared to *your* gear needs

The Meachem policy of making *only industrial gears* means that the entire facilities of the large Meachem shops are devoted exclusively to making the kind of gears you use. Thirty-four years of experience in making industrial gears, 16,000 industrial gear patterns, an organization trained to turn out high-quality work in the shortest possible time, and a convenient location on a trunk line railroad—these are some of the reasons why so many manufacturers have come to regard the Meachem shops as their gear-making department.

It will pay you to test Meachem Gear Service. Just send us a list of your typical gear requirements and let us quote prices and deliveries, or better yet, send us a trial order.

109

THE MEACHEM GEAR CORPORATION

Sole manufacturers of *new process* RAWHIDE GEARS and PINIONS—Still made under the direction of the inventors and the men responsible for every stage in their development.

Canal St. and West Shore R. R.
SYRACUSE, N. Y.

MEMBER OF AGMA





Let Foote Engineers Determine for You the Proper Type of Gear to Use

Every gear should have a margin of safety, for delays are more costly than good gears. However, when you use gears with an unnecessary margin of safety you are incurring useless production cost.

Foote Engineers will determine for you the proper type of gear that will provide the proper margin of safety at lowest cost.

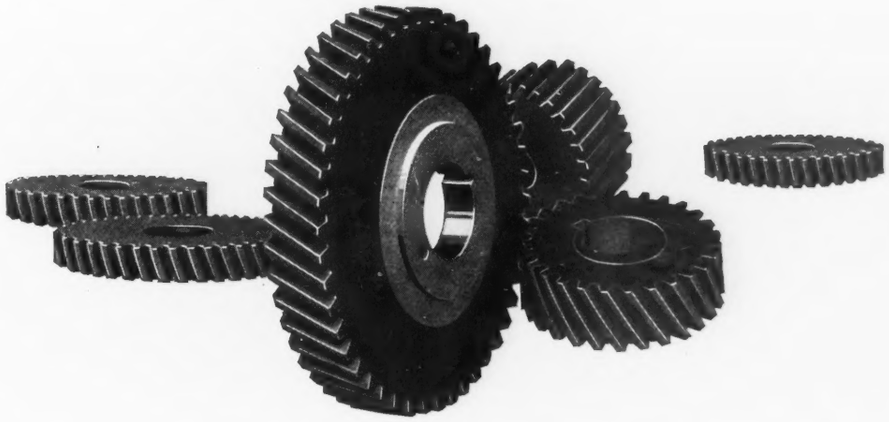
This service is yours without cost or obligation.

Foote Brothers Gear & Machine Company

Manufacturers of cut gears for all purposes

232-242 N. Curtis St. CHICAGO, U. S. A.

FOOTE DEPENDABLE GEARS



Uniformity in Silent Elastic Gears

FORMICA gear blanks are remarkably uniform in all their cutting, wearing and running characteristics.

They provide a non-resonant, noise-absorbing material, of such elasticity that it will take up heavy shocks on the driving train.

Yet it will outwear cast iron—and is so strong that it has been known to tear the teeth out of metal gears.

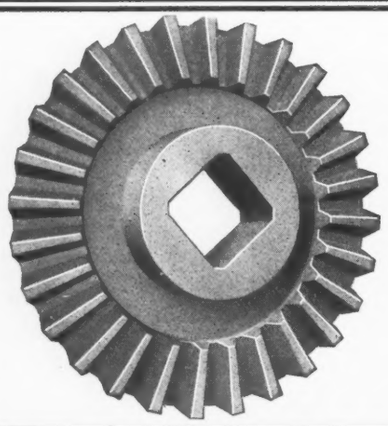
Formica does not shrink or swell. It absorbs no moisture and is unaffected by chemicals, alkalies, and most acids. It is free from erosion and it stays in round.

Formica can be worked readily and accurately at low cost on machines that are commonly used with metal.

The output of Formica has been doubled. All Patent difficulties have been settled. You can have Formica when and as you want it. Let Formica engineers help you solve your problems.

THE FORMICA INSULATION COMPANY
4624 Spring Grove Avenue, Cincinnati, Ohio

FORMICA
Made from Anhydrous Redmanol Resins
SHEETS TUBES RODS



GEARS

for all purposes

BAKELITE and RAWHIDE PINIONS
PLAIN or SPLINED SHAFTS
HARDENED ROLLERS, PINS and BUSHINGS

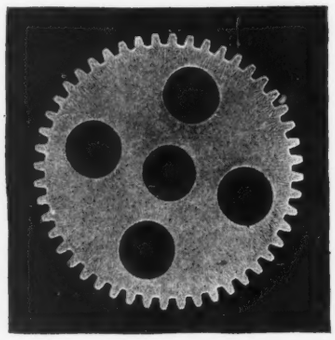
PITTSBURGH GEAR and MACHINE CO.
2700 Smallman St. PITTSBURGH, PA.



Diefendorf Gears

Cast Iron—Steel—Bakelite - Micarta. Durable, Smooth, Long-lived. Made for use in the finest mechanisms. Prices right—guaranteed—real service. May we quote to your specifications?

Diefendorf Gear Corporation
Syracuse, N. Y., U. S. A.



GENERATED

in our

Gear Cutting Department

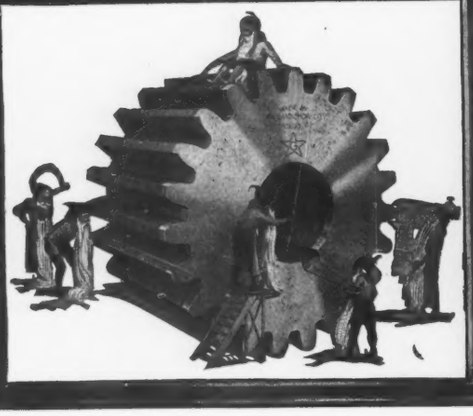
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Let Us Quote You

MEISSELBACH-CATUCCI MFG. COMPANY
54 STANTON STREET NEWARK, N. J.

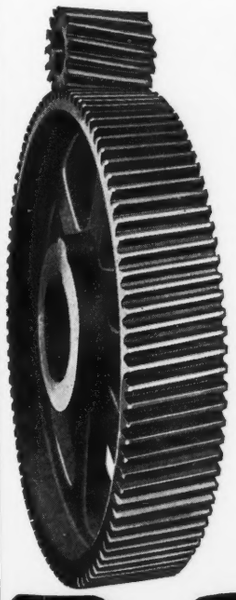
ALL TYPES OF
SPUR—BEVEL—SPIRAL—WORM
GEARS
Also Automobile Gears in Large Quantities
TAYLOR MACHINE COMPANY
7804 CARNEGIE AVENUE CLEVELAND, OHIO

Vacation time—
We're working on Gears
CLOYES GEAR WORKS
1620 Collamer Avenue Cleveland, Ohio



GANSCHOW

"QUALITY"
RAWHIDE AND BAKELITE
PINIONS
WILLIAM GANSCHOW COMPANY
CHICAGO ILLINOIS



Noisy Gears Advertise Vibration

Vibration is the first of the three steps to the scrap pile. If you eliminate the first step you increase gear life—you save *real money*—nothing imaginary about that.

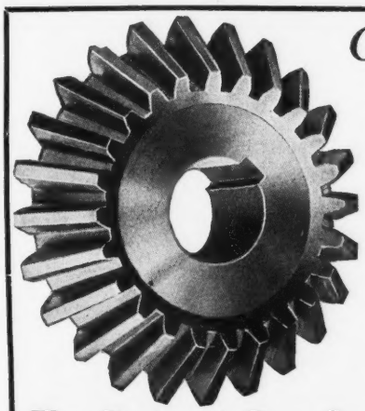
Nuttall Helical Gears Minimize Vibration.

Philadelphia Office
420 Land Title Bldg.

R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

Chicago Office
2133 Conway Bldg.

Nuttall



Good Gears

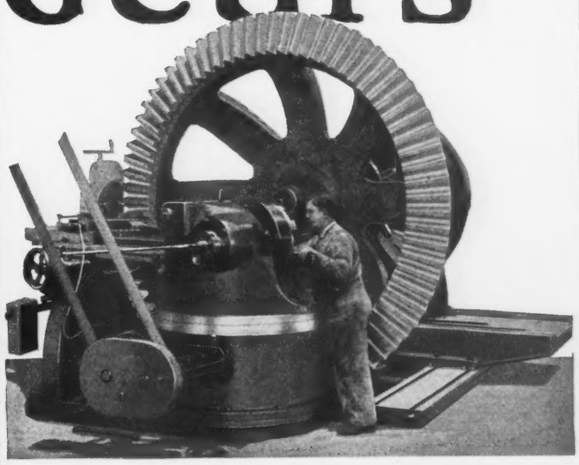
are half the battle for operating efficiency.

Cincinnati Gears

are good gears. The best that can be made, sold at a price that makes them not only efficient but profitable.

The Cincinnati Gear Co., 1825-1841 Reading Road CINCINNATI, OHIO

Earle Gears



Any size—but we specialize in *big gears*. We have the equipment and space to produce the largest gears economically. Let us estimate on your gear needs, any size.

The Earle Gear & Machine Company
4707-15 Stenton Ave. Philadelphia

HERRINGBONE CUT GEARS
MILL DRIVES
SPEED REDUCERS
FAWCUS
SPUR
WORM
BEVEL GEARS
FAWCUS MACHINE CO. PITTSBURGH, PA.

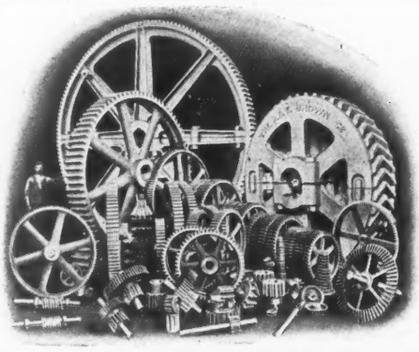


BEVEL GEAR GENERATORS.
BEVEL GEARS
CUT THEORETICALLY CORRECT
Special facilities for cutting Worm, Helical, Miter, Internal and Elliptical Gear Wheels.
The Bilgram Machine Works
1231 Spring Garden Street, Philadelphia, Pa.

GEARS
shown in this cut are
3 in. to 16 ft. in diameter

Some are
machine moulded and
others cut or planed

Of Steel, Semi Steel,
Cast Iron, Bronze,
Rawhide, Bakelite,
Condensite, and Fibre.



GEARS
for
MOTOR, MACHINE, MILL
or POWER PLANT

Planed Bevel Gears up
to 48 in. diam.

Cut Spur Gears up to
96 in. diam.

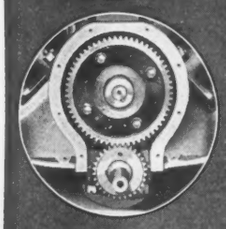
Machine Moulded up
to 192 in. diam.

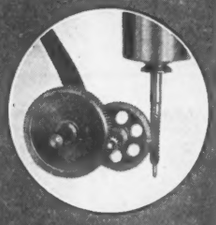
Shafting, Pulleys, Hangers, Friction Clutches, Etc.

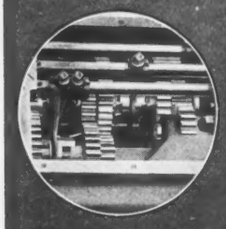
WORKS
ELIZABETHPORT, N. J.

THE A. & F. BROWN CO.

ENGINEERING AND SALES OFFICE
79 BARCLAY ST., NEW YORK







Zones of Quiet" GEARS

—give added quality and value to the machine on which they are used. Their noticeable smoothness in operation and the absence of harsh, grinding gear noises always attract favorable attention and mention.

Perhaps your product would be improved by the use of "Zones of Quiet" Gears. We make

Spur, Helical, Bevel, Mitre, Spiral, Worm Gears and Worm Wheels in all Metals —also in Bakelite

Capacity of our shops 10,000 finished gears daily.

If interested, send blue print or sample Gear for estimate

ALBAUGH-DOVER CO.
2100 Marshall Blvd. Chicago

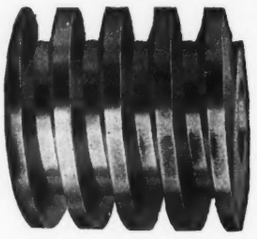
BOSTON GEARS

The trade mark of Quality gears made in a daylight shop.

We have facilities for producing gears for light or heavy duty up to 72" diameter in any material.

Special rates in cutting teeth in customers' blanks. Prompt deliveries assured.

600,000 gears in stock



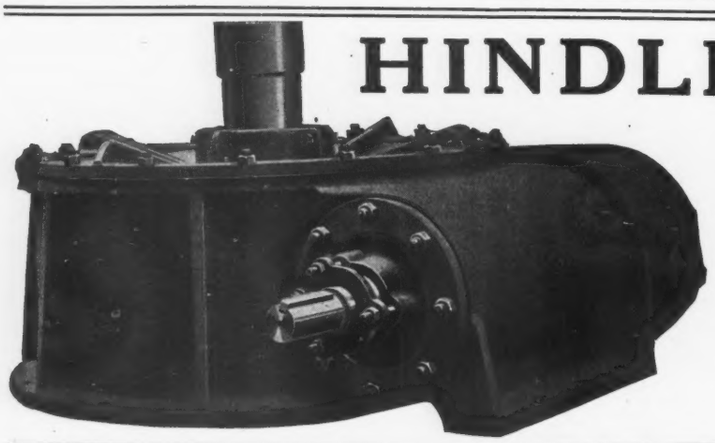
1500 sizes

Hardened steel worms with threads ground; steel helical gears, soft and hardened with threads ground; worm gears, spurs, miters, bevels, internals, sprockets.

Send blueprints or sketch for estimate.
Catalog of stock gears free on request.

BOSTON GEAR WORKS
22 Hayward Street Norfolk Downs, Mass.
Branches at NEW YORK CHICAGO CLEVELAND

HINDLEY GEARS



Folks Who Have Used Them for Years Are Still Satisfied

In the list of distinguished Hindley Gear users you'll find many firms using drives demanding the utmost in safety and efficiency. These people have been using Hindley Gears for years, and they continue to specify them because of the satisfaction gained. Hindley's are adapted to high speeds, heavy pulls and rigorous service. We are certain they will please you. Write for particulars.

HINDLEY GEAR COMPANY
1105 Frankford Ave. Philadelphia, Pa.

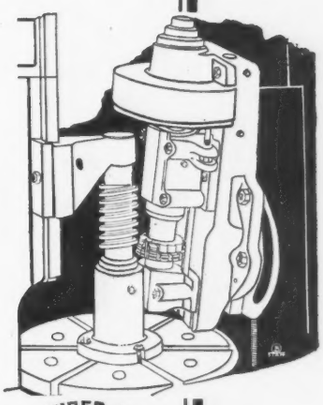
Generated Worms

Greater Accuracy
" Production
" Satisfaction

is attained by employing the G & E Worm Hobbing Method, (*Patents applied for.*) than is possible by any other process.

Progressive manufacturers find it the most economical and speediest method available to keep apace with large production schedules.

Shall we submit facts? Send us blueprints of the worms you use.



MEMBER OF AGMA

GOULD & EBERHARDT

"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY
ESTABLISHED 1833 NEWARK, N.J. U.S.A. CHANCELLOR AVE.

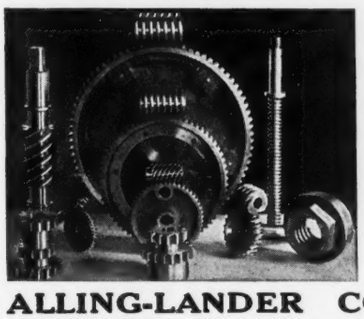
CONNECTICUT GEARS
INCORPORATED 1921

5 P or finer spur or worm gears 36" or smaller
10 P or finer helical, spiral, herringbone 8" or smaller

545 Cooke St., WATERBURY, Conn.

May we quote? ***Formica?***

ALLING-LANDER GEARS ENHANCE YOUR PRODUCT

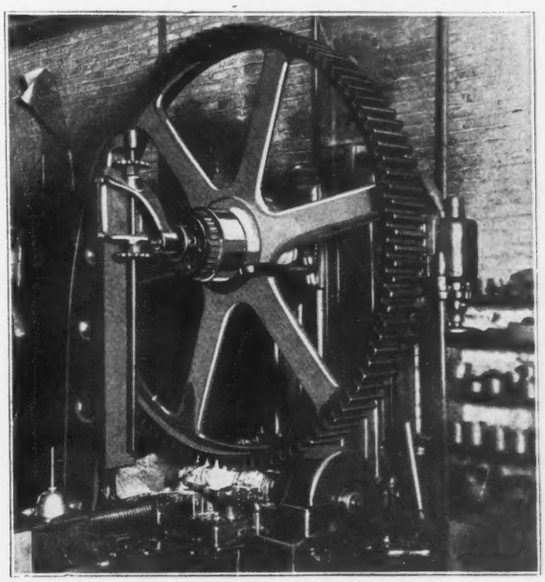


Put Alling-Lander Gears in your machines and insure silent, smooth, easy operation. Silent operation is a talking point that wins new buyers of any mechanical product.

Alling-Lander gears are high in quality of finish and accuracy. Prices are fair. Deliveries according to promise. Send your prints and specifications for quotation.

ALLING-LANDER COMPANY, Inc.
BASKET STREET *Makers of "The Gear You Can't Hear"* SODUS, N. Y.

JAMES
CUT GEARS AND SPEED REDUCING TRANSMISSIONS



GEARS—Any kind, any size and any quantity
Satisfaction Assured

D. O. JAMES MFG. COMPANY
1114 W. Monroe Street
CHICAGO ILLINOIS

MEMBER OF AGMA

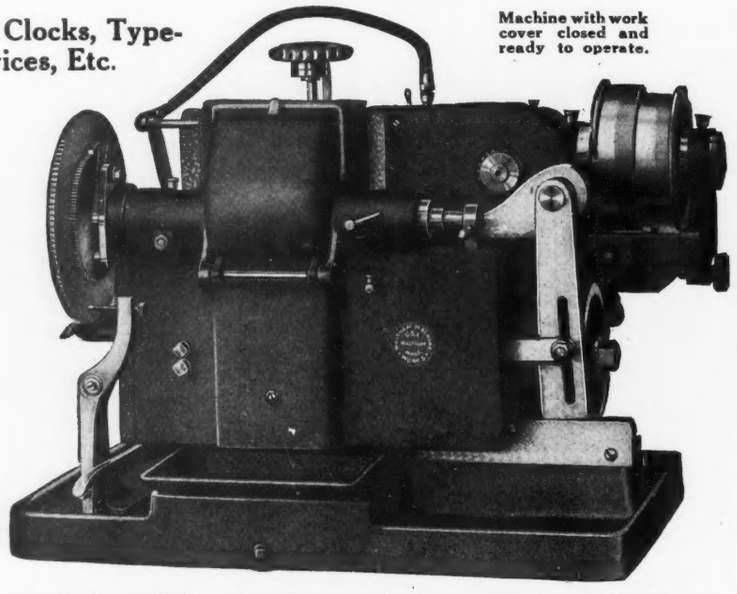
Waltham Pinion and Gear Cutting Machines

4" SPUR GEAR CUTTING MACHINES OF PRACTICAL DESIGN AND CAREFUL WORKMANSHIP

Of interest to Manufacturers of Clocks, Typewriters, Watches, Recording Devices, Etc.

Machines so nearly automatic that they can be operated to good advantage in battery; that occupy only 18" by 28" of bench room, and provide four cutting speeds—300 and 375 R.P.M. for steel work, 1200 and 1500 R.P.M. for brass—and a standard 10" index with 120 divisions—8 to 120.

Though these machines are designed for production, they are so easily set up that they are equally profitable for jobbing; and individual geared pump, silent chain drive, plenty of ball bearings and other "quality" features insure uninterrupted satisfaction and low maintenance costs. Catalog on request.

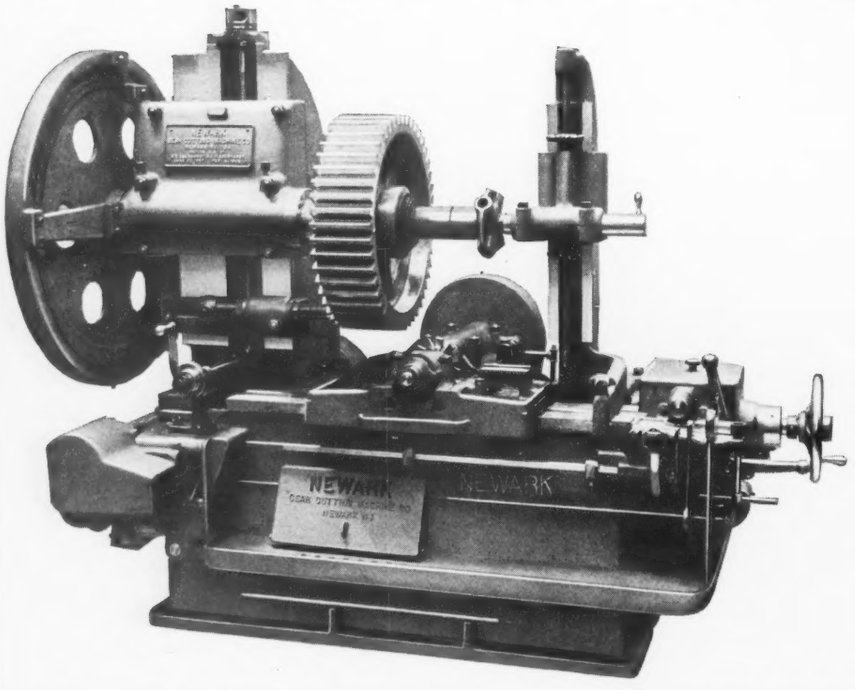


Machine with work cover closed and ready to operate.

Small Thread Millers, Gear Cutters and other small Automatic Machines

WALTHAM MACHINE WORKS, Newton St., Waltham, Mass.

Newark Spur Gear Cutting Machine



Newark Spur Gear Cutting Machines, for steady everyday run of gears.

Highest production per day. Lowest upkeep.

Nothing complicated to confuse the operator or to get out of order.

NEWARK GEAR CUTTING MACHINE CO.

NEWARK HENRY E. EBERHARDT, President **NEW JERSEY**

CASLER TOOLS

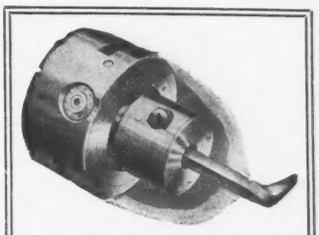
The Twin-Screw Drill Chuck



Strong, safe and durable. Takes a firm grip on the drill shank and drives even a No. 80 without distortion. Made of best material—completely interchangeable — and in three practical sizes—½", ¾" and 1" capacity.

Try One for 30 Days at Our Expense

Marvin & Casler Company
CANASTOTA NEW YORK



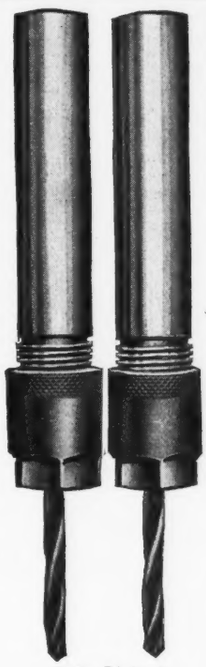
Our Off-Set Boring Head

Accurate to thousandths, quickly adjustable; locks tool securely in position. Fine for drill press, milling machine or turret. Five sizes—½" to 1½". More details on request.

TRUMP

DRILL CHUCKS

Designed and Built for Production



Only ⅝ inch between centers

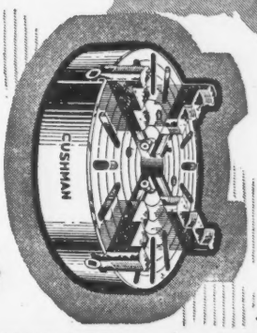
"Use the Trump—see profits jump"

Just what you need for production — Trump Drill Chucks. They are made from hardened steel, well finished, accurately centered, economical, efficient. The Trump is small, handy, and low priced. The No. 2 for instance (capacity up to ¼") costs only $3.50.

Trumps come in three sizes: No. 1, 0" to ⅛"; No. 2, 0" to ¼"; No. 3, 0" to ⅜". Shipments of chucks or chuck parts are prompt. Send your trial order today.

Trump Brothers Machine Company
Established 1872
Wilmington Delaware, U. S. A.

"CUSHMAN" CHUCKS 1862

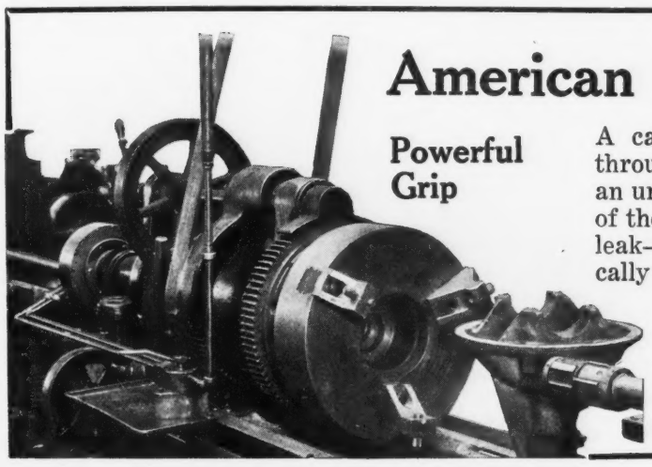


The "Incomparable"

THE NEW STEEL CHUCK
Improved Body Design
Perfectly Aligned Hard-Surfaced Jaws
Hard Self-Cleaning Screws
Self-Aligning Thrust Bearings
Interchangeable Parts
THE CUSHMAN GUARANTEE

The Cushman Chuck Company
Hartford, Conn., U.S.A.

American Air Operated Chuck



Powerful Grip

A cam on the draw sleeve multiplies the power through a combination wedge movement providing an unusually powerful grip which is a characteristic of the American Chuck. American Cylinders do not leak—the piston packing is kept air tight automatically by the air pressure itself.

Send for a circular—study the details

The S-P Manufacturing Co.
872 East 72nd Street Cleveland, Ohio

THE NEY

"Positive Grip"
Collet Chuck

A Self-Contained Unit Adapted to An Unusually Wide Range of Work



The purchase of a Ney Chuck is a real economy. It can handle such a wide range of work and its uses are so varied that one Ney Chuck will often take the place of several others. It's only a question of using whichever one of the six collets will accommodate the work.

Sizes of Collets: 3/8, 1/2, 5/8, 3/4, 7/8 and 1 inch.

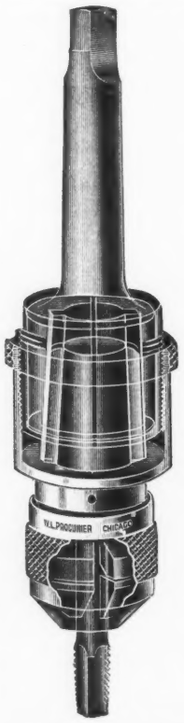
It is tightened rapidly by means of a key and closes on the work with an unbreakable grip; but it leaves absolutely no mark. Adapted for either rough or finished bar stock.

Compact, rigid and powerful, with no projecting portions to injure the operator's hands, it is possible to bring the tool close to it without danger from revolving parts.

Write for interesting folder showing Ney Chuck in action.

The J. M. Ney Co.
Hartford, Connecticut
U. S. A.

The PROCUNIER



"Double-Jaw" Safety Tapping Chuck

Twenty-four holes 3/4" deep, 7/16" in diameter, every three minutes, *without tap breakage.* Only one of the many production records made by machines equipped with Procunier "Double-Jaw" Tap Chucks. Correct chucking not only speeds production but saves taps and cuts tapping costs. Our circular shows the "Procunier Line" of Tapping Attachments in operation and quotes actual production records.

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William L. Procunier
18 So. Clinton St. Chicago, Ill.

SWEETLAND CHUCKS

Standardize them and You'll Advertise them



Equip with Sweetland Chucks and you'll like them so well you'll advertise them to your friends.

Here is the style No. 40 Four-Jaw Combination Chuck.

Powerful reversible jaws operate independently or universally. Sizes 6" to 24", stepping 3" between each; up to 42", stepping 6".

Write for catalog 13C.

The Hoggson & Pettis Manufacturing Co.
New Haven Connecticut

Lavoie Air Chucks

See them in operation; note the small number of parts, the simplicity of operation. No objectionable cylinder at rear of spindle; only a single line of piping required.

The Frontier Chuck and Tool Co., Inc.
30 Letchworth St. BUFFALO, N. Y.

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Geared Drill Chucks
Standard Drill Chucks
Independent Lathe Chucks
Geared Scroll Lathe Chucks
Combination Lathe Chucks
Right Angle Transmission
Flexible Arms
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Micrometers
Fine Mechanical Tools

Illustrative Descriptive Bulletins Mailed upon Request

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Graduated Adjustable Friction Self-Centering

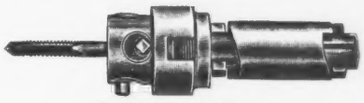
Tap Holder for Turret Lathe

TAPS STEEL as safely as Cast Iron

Regulates the Whole Power of Machine to Just Drive, but Cannot Break Tap. When Tap Sticks (or Strikes Bottom) the FRICTION SLIPS, and Tap can thus be Run In and Out until the Toughest Metal is Quickly Tapped.



Interchangeable Spring Shanks for Rough and Finish Taps occupying One Turret Hole.



Double Clutch Sleeve

Especially Good for Roughing and Finishing Taps, Running Solid Dies Up Against a Shoulder, etc.

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BROADWAY and JOHN ST., NEW YORK

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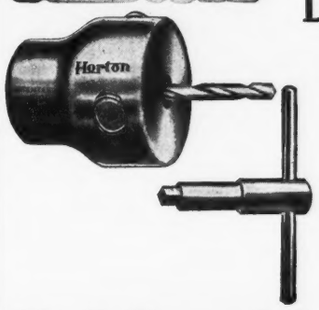
Western Branch: Machinery Hall, 109 So. Jefferson St. Chicago, Illinois

New England Branch: 830 Old South Building, Boston, Mass.

Catalog Francais: Edgar Bloxham, Paris, 12 Rue du Delta

Horton

Two-Jaw Drill Chucks



Simple—compact, two jaws, single screw, solid body. Made for hard work and severe use. Seven sizes from 0-1/4″ to 0-2″.

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The Chuck That Never Slips.

The More You Crowd It,

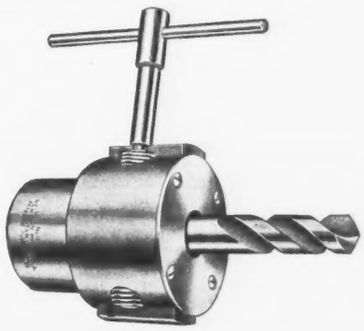
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NARRAGANSETT MACHINE CO.

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Begin with Practical Chucks

Union Chucks are designed to economize time and are made in sizes and styles to meet every requirement. Every chuck fully guaranteed. A feature of this Positive Friction Drill Chuck is the Transverse Slot which provides for using drills with tenons. Seven sizes—0 to 2″.



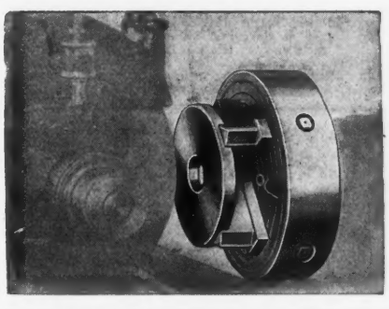
Complete line described in catalog which we'll be glad to send on request

Union Manufacturing Company

New York Office 26 Cortlandt Street — New Britain, Conn., U. S. A.

Makers of a Complete Line of Chucks

SKINNER CHUCKS T. M.



GRINDING MACHINE CHUCKS

This type of chuck was designed and perfected for use on grinding machines. The slots in the face are less exposed than usual; hence, the operating screws that move the jaws are well protected from emery dust.

The patented two-piece reversible jaws can easily be reversed without removing the jaw body. Strong, dependable, accurate.

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NEW BRITAIN, CONN U.S.A

ESTABLISHED 1887.

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The CARD Quality

More than 48 years' experience is back of the dependability for which Card Threading Tools are famous. Design, workmanship and heat-treatment are right. Endorsed by accurate, economical performances in many well-known shops.

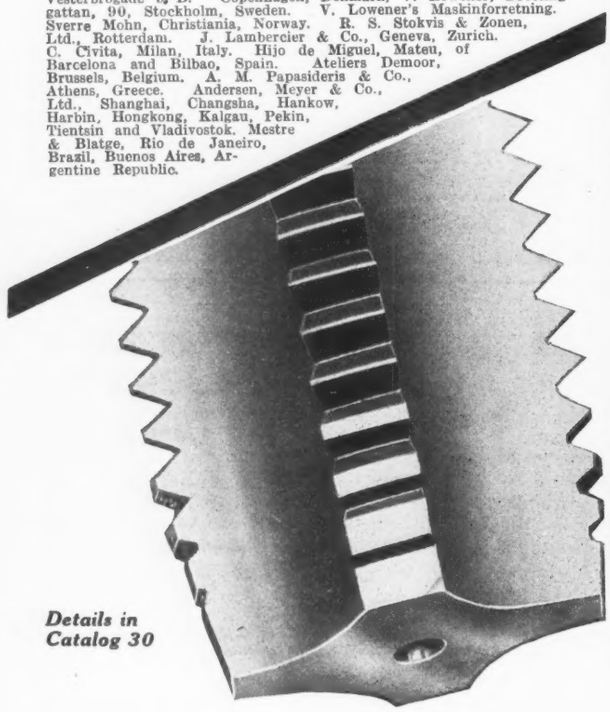
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Division of Union Twist Drill Co.

MANSFIELD MASS., U. S. A.

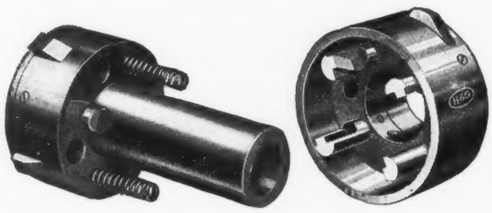
New York Office: 62 Reade Street

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Details in Catalog 30

Simple! *Substantial!* *Dependable!*



A Surprise Awaits You!

WHEN you send for one of the H & G dieheads and put it to work on one of your own machines, operated by one of your own men, a surprise awaits you.

You will be amazed at the way this diehead cuts threads—the speed, the accuracy, the toolroom quality of the work.

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The diehead closes, the stock goes in. The thread is cut—clean, smooth, perfect. **Click!** The diehead flies open, ready for the next piece.

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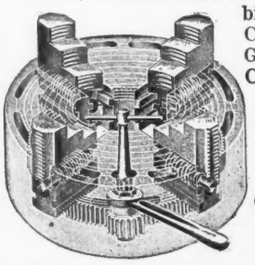
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Styles and sizes for any machine on which threading is done

If you want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.



Spur Geared Scroll Combination Lathe Chuck



Strongest Grip, Greatest Capacity Great Durability and Accuracy

WESTCOTT CHUCK CO.

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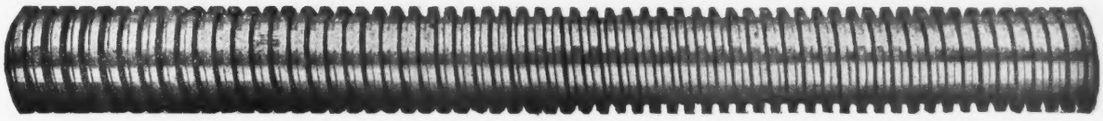


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Nothing Made is 100% Perfect!

But Hindley Screws are as near to 100% perfection as it is possible to manufacture them. Nothing in its class is finer—nothing more accurate—nothing more efficient. Any pitch, size, thread and quantity. Our service is real. Write us about it.



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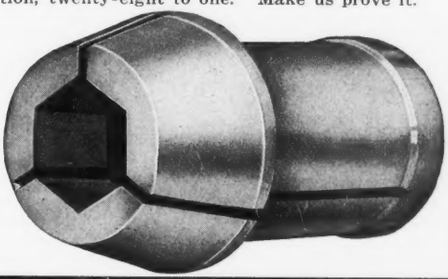
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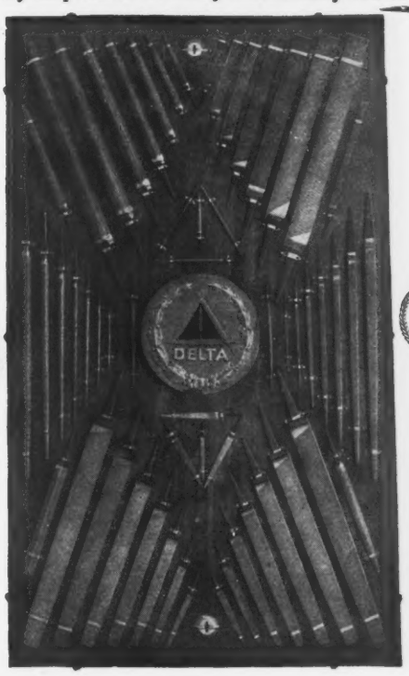
Manufacturers and Patentees

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Used in Every Shop Where Economy and Efficiency Are Practiced



The File you will eventually use—as perfect as will and skill can make—clean, strong, sharp teeth

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The Gammons Taper Pin Reamer

Saves 65% of Reaming Costs

It reams in any metal at least three times as fast as fluted reamers and the average breakage is one-tenth that of the best fluted reamers made.



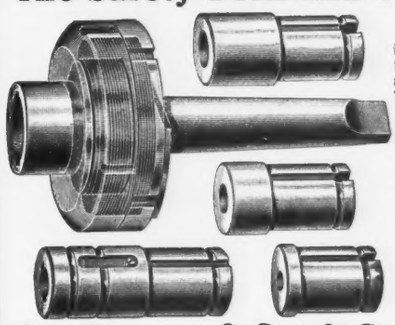
For use in a drill press, or electric or air drill. May be run at any reasonable feed or speed without fear of breakage.

Why not save the two-thirds in costs? Only too glad to explain fully

The Gammons-Holman Co.

Dept. M. Manchester, Conn.

The Safety Drill and Tap Holder

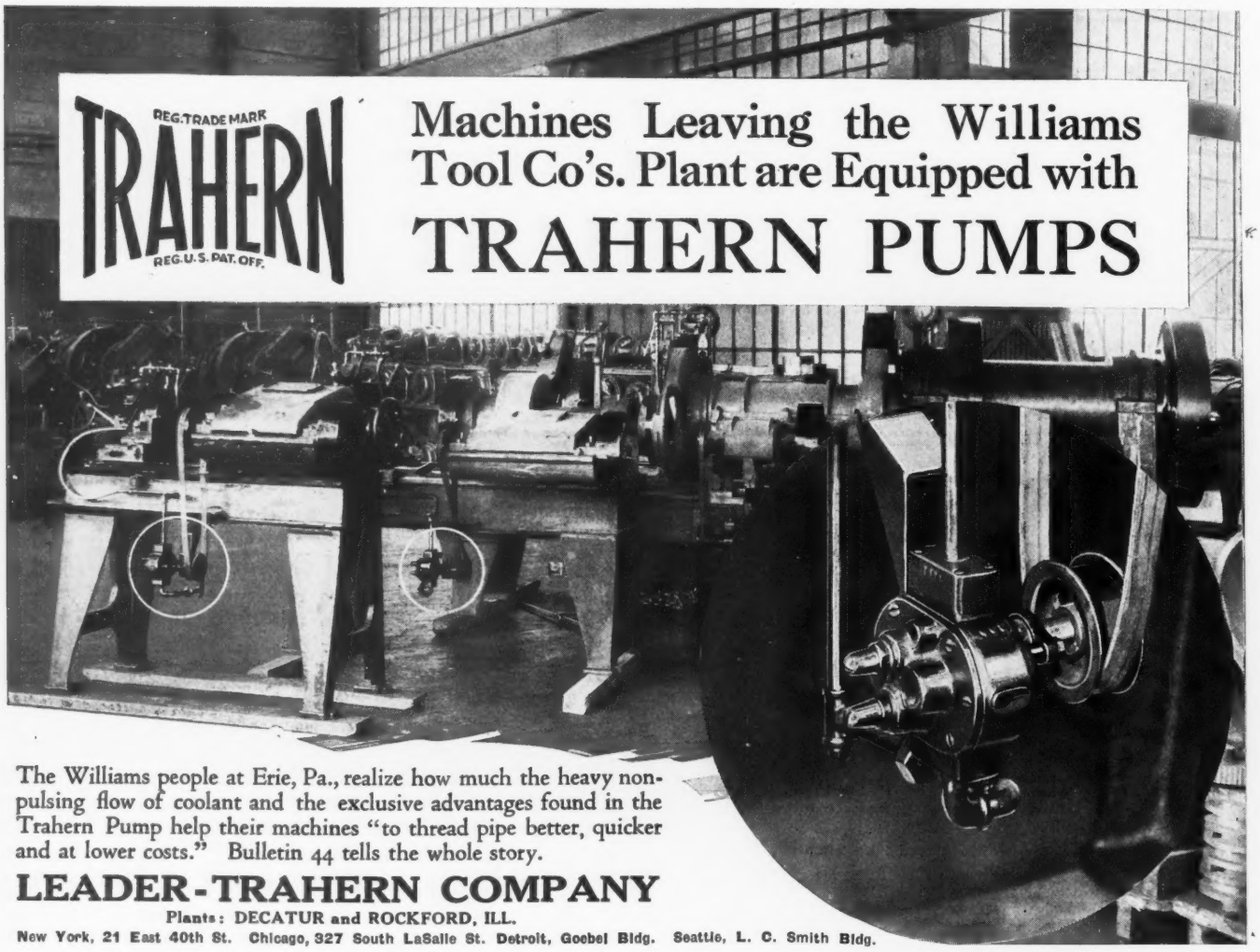


is the only attachment for the purpose that gives universal satisfaction and is unequalled in efficiency, convenience, rapidity, accuracy and simplicity. Nothing to break or get out of order. Made in 4 sizes, covering from 0 to 2½ inches diameter. Can be furnished with special sprockets with friction set to carry one or two sizes of taps, useful if sizes are constantly changing.

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TRAHERN
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Machines Leaving the Williams Tool Co's. Plant are Equipped with
TRAHERN PUMPS



The Williams people at Erie, Pa., realize how much the heavy non-pulsing flow of coolant and the exclusive advantages found in the Trahern Pump help their machines "to thread pipe better, quicker and at lower costs." Bulletin 44 tells the whole story.

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Specify Empress No. 52

The most efficient operation and life of your machines depends largely on proper lubrication—the right type of oil cup—and Empress oil cups are right.

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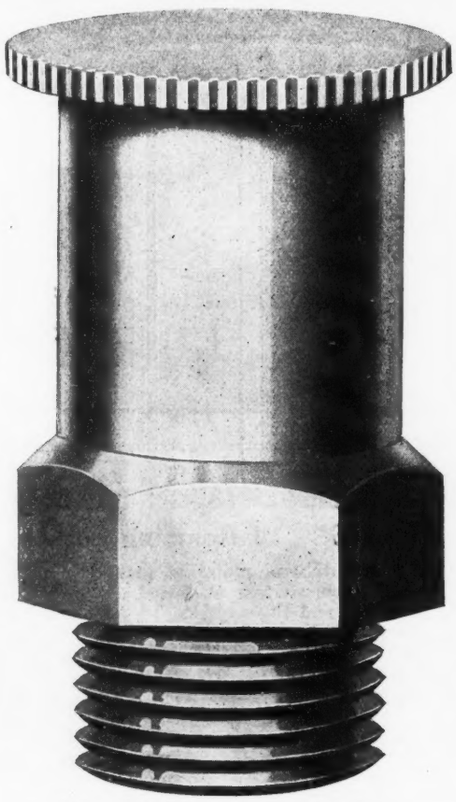
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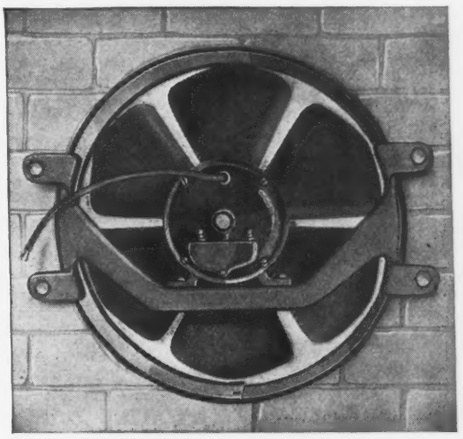
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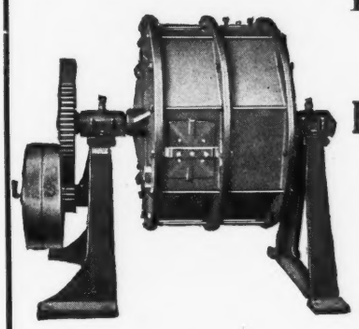
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Send us the dimensions and ceiling height of each of your departments and let us quote on the necessary fan equipment.
Prices about *half* those usually charged.
Also ask us about larger and smaller fans, high, low and medium speed with constant or variable speed motors.

Marathon Electric Mfg. Company
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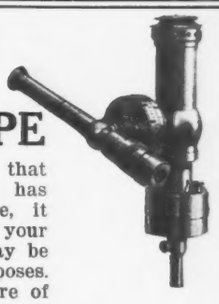
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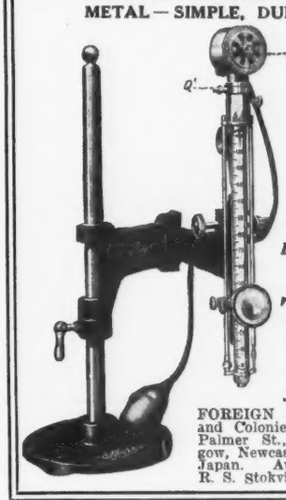


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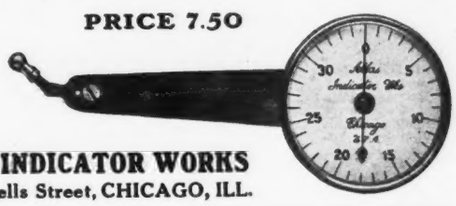
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Reads over a range of 0.055"—at a glance. Dial may be set at zero after adjusting to work. Contact point can be locked in position for inspecting. Keep it in your pocket and use it anywhere. Details?

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Economically operated by 1/6 H.P. motor.

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Electric Welding Machines
Our Specialty

Complete line of standard SPOT and BUTT welders.

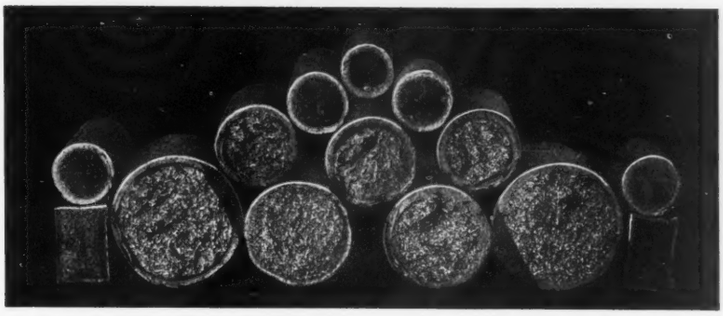
Special machines designed for the rapid production of SPOT, BUTT and SEAM welded work.

Write our nearest representative for catalog of standard welders.

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Office Corner of Spring and Lafayette Streets
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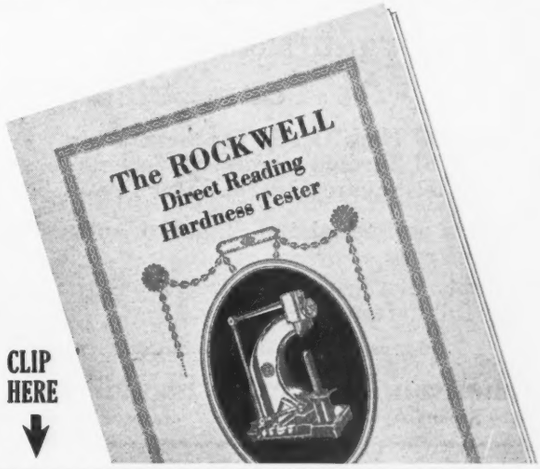
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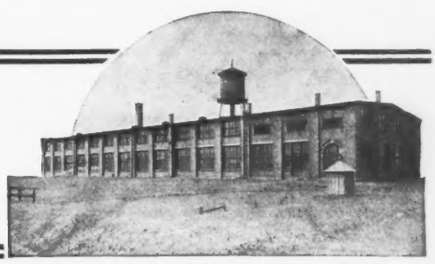
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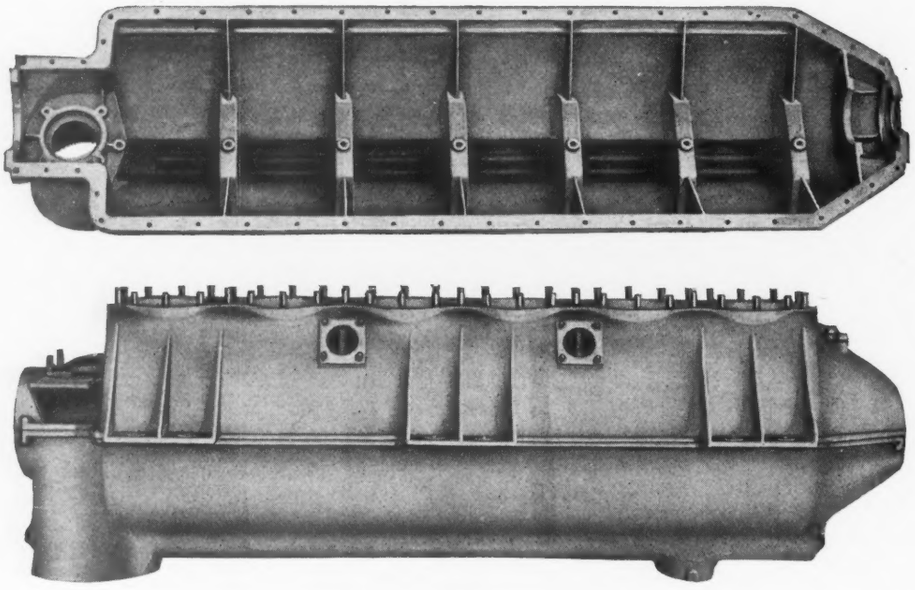
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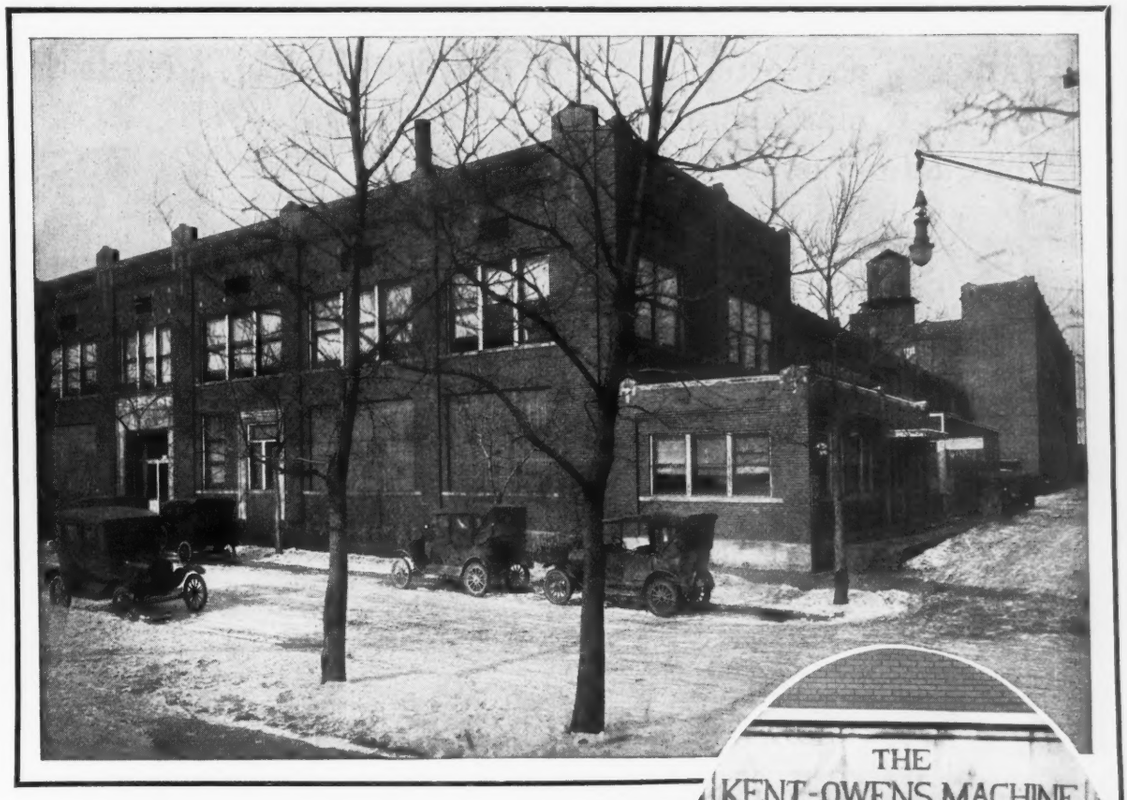
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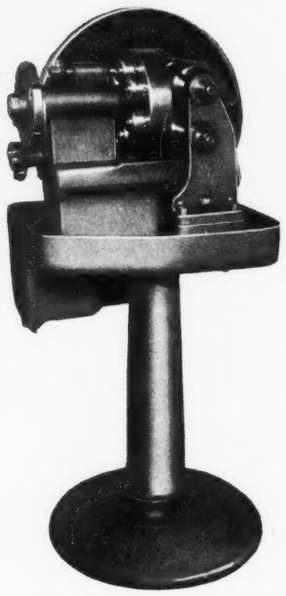
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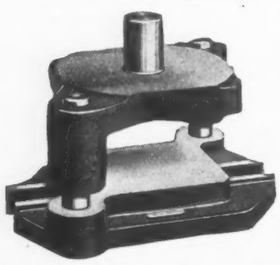
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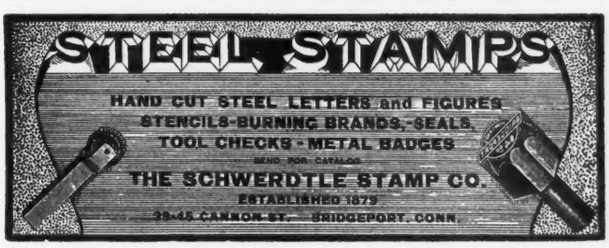
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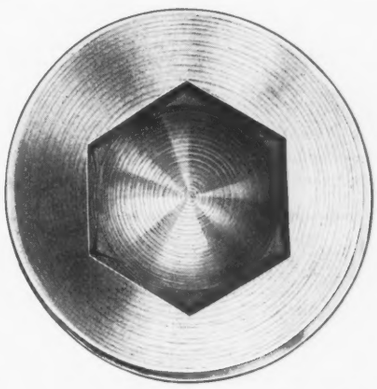
as original equipment

Just reflect what happens when they **don't** have Safety Set Screws.

Your machine may be perfectly adjusted for certain work. A feeder or unskilled mechanic will likely tamper with the adjustment—if there's a square head projecting screw to invite his "monkeying" with a monkey wrench!

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the 30% stronger hollow screw

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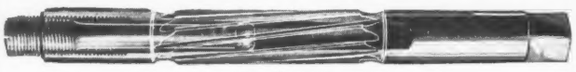
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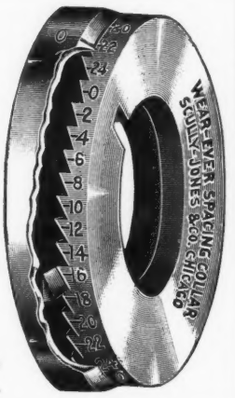
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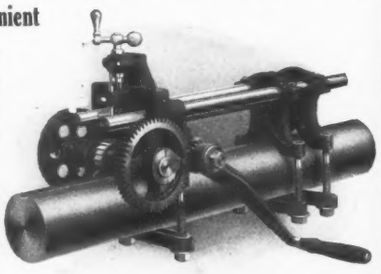
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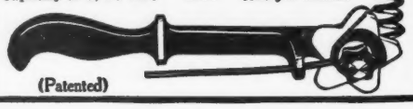
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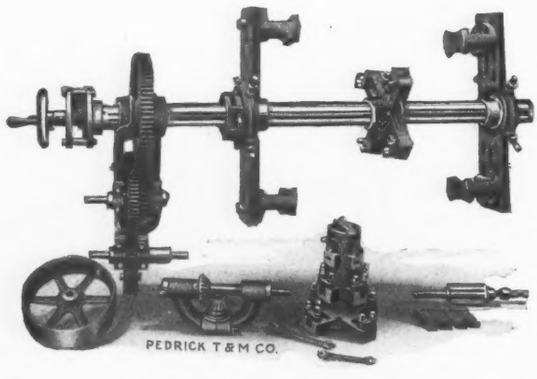
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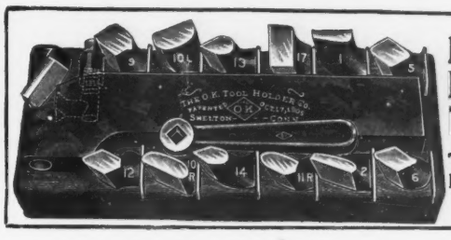
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AMERICAN MACHINERY AND TOOLS
Dutch East Indies, Bandoeng
U. S. A., Singer Building, New York, N. Y.

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New York Office: 15 Whitehall Street.

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MACHINERY AND TOOLS.

SAM LAGERLOF'S MACHINE-BUREAU Stockholm
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A most interesting general review of "The Machine Tool Trade in Japan" will be found on page 983 this number of MACHINERY. The information, which was furnished by Yamatake & Co., of Tokyo, Japan, will be of great value to the American manufacturer who is desirous of securing and holding Japanese trade. The company also offers some practical suggestions in the matter of handling and shipping, which, if followed, will go far towards avoiding the troubles that commonly beset the exporter.

MACHINERY'S PRODUCT INDEX

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 275-276

ABRASIVE CLOTH AND PAPER
Carborundum Co., Niagara Falls, N. Y.

ACCUMULATORS, HYDRAULIC
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Eng. Works, Charles F., 222 North Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Niles-Bement-Pond Co., 111 Broadway, New York.
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Southwark Foundry & Machine Co., Philadelphia.
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ACETYLENE APPARATUS
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Air Reduction Sales Co., Inc., 342 Madison Ave., New York.
Prest-O-Lite Co., Inc., 30 E. 42d St., New York.

AIR HOISTS
See Hoists, Air.

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Baush Machine Tool Co., Springfield, Mass.
Haynes Stellite Co., 30 E. 42d St., New York.
Standard Alloys Co., Pittsburgh.
United Alloy Steel Corp., Canton, O.
Vanadium-Alloys Steel Co., Pittsburgh.

ANGLE PLATES, UNIVERSAL
Boston Scale & Mch. Co., Boston.

ANVILS
Columbian Hardware Co., Cleveland.
Yost Mfg. Co., Meadville, Pa.

ARBOR PRESSES
See Presses, Arbor.

ARBORS AND MANDRELS, EXPANDING
American Broach & Machine Co., Ann Arbor, Mich.
Eastern Tube & Tool Co., Brooklyn, N. Y.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Western Tool & Mfg. Co., Springfield, Ohio.
Whitman & Barnes Mfg. Co., Akron, Ohio.

ARBORS AND MANDRELS, SOLID
Alvord Reamer & Tool Co., Millersburg, Pa.
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Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

BABBITT
Ajax Metal Co., Philadelphia, Pa.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Doehler Die Casting Co., Brooklyn, N. Y.
Hoyt Metal Co., St. Louis, Mo.

BALANCING EQUIPMENT
Anderson Bros. Mfg. Co., Rockford, Illinois.
Divine Bros. Co., Utica, N. Y.
Norton Co., Worcester, Mass.
Rockford Tool Co., 2400 Eleventh St., Rockford, Ill.

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Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Gwilliam Co., 253 West 58th St., New York.
Hoover Steel Ball Co., Ann Arbor, Mich.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.

BARS, BORING
See Boring Bars.

BEARINGS, BABBITT
Franklin Die-Casting Corp., Syracuse, N. Y.
Johnson Bronze Co., New Castle, Pa.
Link-Belt Company, Chicago.
Royersford Fdry. & Machine Co., 54 North 5th St., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Bantam Ball Bearing Co., Bantam, Ct.
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Southwark Foundry & Machine Co., Philadelphia.
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See Hoists, etc.

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National Acme Co., Cleveland.
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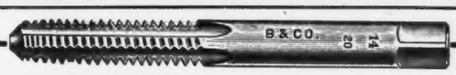
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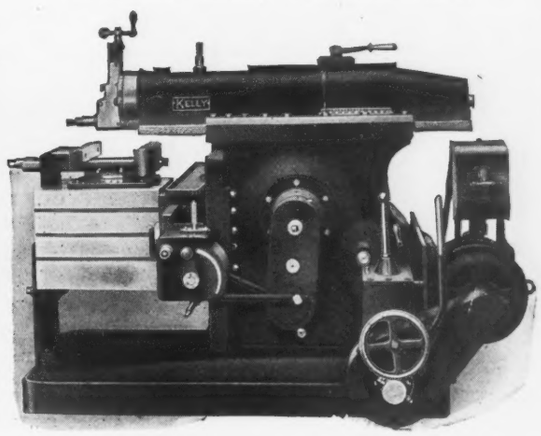
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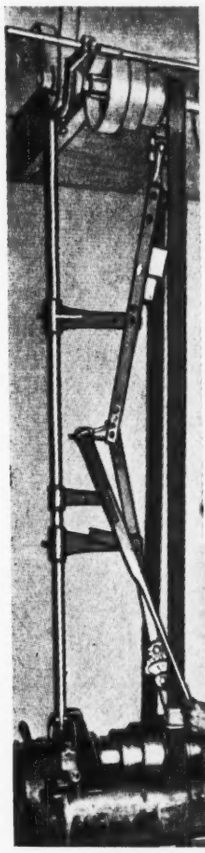
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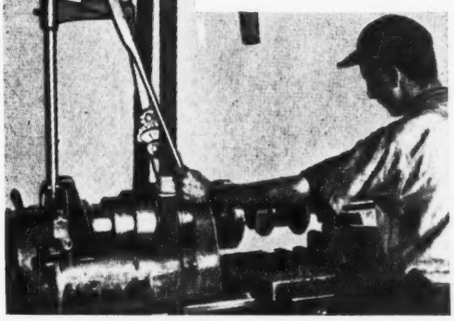
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Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

COUPLERS, HOSE

Greene, Tweed & Co., 109 Duane St., New York.
Ingersoll-Rand Company, 11 Broadway, New York.

COUPLINGS, CUT-OFF, FRICTION

Edgemont Machine Co., Dayton, O.
Johnson Machine Co., Carlyle, Manchester, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUPLINGS, FLEXIBLE SHAFT

Boston Gear Works, Norfolk Downs, Mass.
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Cresson-Morris Co., Philadelphia.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Nuttall Co., R. D., Pittsburgh.
Smith & Serrell, Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUPLINGS, PIPE

Dart Mfg. Co., E. M., Providence, R. I.

COUPLINGS, SHAFT

Brown Co., A. & F., 79 Barclay St., New York.
Brown Engineering Co., 133 N. Third St., Reading, Pa.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Cresson-Morris Co., Philadelphia.
Hilliard Clutch & Mchy. Co., Elmira, N. Y.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Royersford Foundry & Mch. Co., 54 No. 5th St., Philadelphia.
Sellers & Co., Inc., Wm., Philadelphia.
Smith & Serrell, Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

CRANES

Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Link-Belt Company, Chicago.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Northern Engineering Works, Detroit.
Vandyck Churchill Co., 149 Broadway, New York.
Wright Mfg. Co., Lisbon, O.

CRANES, ELECTRIC TRAVELING

Link-Belt Company, Chicago.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Northern Engineering Works, Detroit.
Roeper Crane & Hoist Works, Reading, Pa.

CRANES, HAND TRAVELING

Hanna Engineering Works, 1763 Elston Ave., Chicago.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Roeper Crane & Hoist Works, Reading, Pa.

CRANES, LOCOMOTIVE

Hanna Engineering Works, 1763 Elston Ave., Chicago.
Link-Belt Company, Chicago.

CRANES, PORTABLE

Canton Fdry. & Mch. Co., Canton, O.

CRANK PIN TURNING MACHINES

American Tool Works Co., Cincinnati.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Lodge & Shipley Machine Tool Co. Cincinnati.
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Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

CRUCIBLES

Dixon Crucible Co., Joseph, Jersey City, N. J.

CUTTER COMPOUND

See Compound, Cutting, Grinding, etc.

CUTTER SALVAGE

Eastern Cutter Salvage Corp., Newark, N. J.

CUTTERS, BALL BEARING LATHE

Snellex Mfg. Co., Rochester, N. Y.

CUTTERS, MILLING

Alvord Reamer & Tool Co., Millersburg, Pa.
Barber-Colman Co., Rockford, Ill.
Becker Milling Machine Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland.
Cowles Tool Co., Cleveland.
Detroit Twist Drill Co., Detroit.
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Gould & Eberhardt, Newark, N. J.
Greenfield Tap & Die Corp., Greenfield, Mass.
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Kearney & Trecker Corp., Milwaukee, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit.
Newark Gear Cutting Machine Co., Newark, N. J.
O. K. Tool-Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Weldon Tool Co., Cleveland.
Whitney Mfg. Co., Hartford, Conn.

CUTTING-OFF MACHINES, ABRASIVE WHEEL

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Greenfield Tap & Die Corp., Greenfield, Mass.

CUTTING-OFF MACHINES, COLD SAW

See Sawing Machines, Circular.

CUTTING-OFF MACHINES, ROTARY

Brown & Sharpe Mfg. Co., Providence, R. I.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Etna Machine Co., Toledo, O.
Fawcus Machine Co., Pittsburgh, Pa.
Hurlbut, Rogers Mchy. Co., South Sudbury, Mass.

CUTTING-OFF TOOLS

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

CYCLOMETERS

Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

CYLINDER BORERS

Baker Bros., Toledo, O.
Beaman & Smith Co., Providence, R. I.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

CYLINDER BORING MACHINES, PORTABLE

Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. E., Philadelphia.

DEALERS, MACHINERY

Allen, H. F., 30 Church St., New York.
Bath & Co., Cyril J., Cleveland.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Brownell Mchy. Co., Providence, R. I.
Cadillac Machinery Co., Detroit.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
Essley Machinery Co., E. L. 555 Washington Blvd., Chicago.
Garvin Machine Co., Spring and Varick Sts., New York.
Hill, Clarke & Co. of Chicago, 649 Washington Blvd., Chicago.
Kinsey Co., E. A., Cincinnati.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osgood Tool Co., J. L., Buffalo, N. Y.
Oviatt & Co., D. C., Cleveland.
Prentiss & Co., Inc., Henry, 149 Broadway, New York.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Vandyck Churchill Co., 149 Broadway, New York.

DEMAGNETIZERS

Heald Machine Co., 16 New Bond St., Worcester, Mass.
Luma Electric Equipment Co., Toledo, O.
Walker Co., Inc., O. S., Worcester, Mass.

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Manufacturing Consulting Engineers, Syracuse, N. Y.

DESKS, STEEL FACTORY

Lupton's Sons Co., David, Philadelphia, Pa.

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Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.

DIAMOND TOOLS

Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.

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Dyson & Sons, Joseph, Cleveland.

DIE CASTINGS

See Castings, Die or Die Molded.

DIE CUSHIONS, PNEUMATIC

Marquette Tool & Mfg. Co., 331 West Ohio St., Chicago.

DIE FORMING MACHINES

Anderson Die Machine Co., Bridgeport, Conn.

DIE SINKERS, AUTOMATIC

Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y.

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FACTS ABOUT PRODUCTION

ON A LARGE TRACTOR MOTOR

Machine has power and rigidity at high speeds

Proper fixtures hold and support the work

Properly constructed cutter bodies hold and support the blades

Result: Stellite blades roughing and finishing remove metal rapidly and accurately at the lowest possible cost



ACCUMULATIVE TOOL & LABOR COSTS SAVING OF MAN & MACHINE HOURS AND INCREASED RETURNS ON INVESTMENT

SHOWN BY MOTION STUDY PLAN	STELLITE	OTHER TOOLS
Cylinder heads per grind	173	30
Cuts per grind	519	90
Grinds to life 1 set cutters	128	128
Cuts to 1 set of blades	66432	11520
Hours required for 66432 cuts	2214	2768
Grinds required for 66432 cuts	128	738
One set of blades	$82.26	$34.91
Blades to mill 66432 cuts	82.26	201.29
Fitting extra blades	0.00	59.62
Grinding to mill 66432 cuts	44.80	258.30
Total tool cost 22144 castings	127.06	519.21
Total tool cost per casting	.0057	.0234

STELLITE SAVINGS

Labor and machine cost @ $1.00 per hour $554.00
Tool cost 392.15

TOTAL SAVINGS $946.15

Haynes Stellite Company

Carbide and Carbon Building
30 East 42nd Street, New York

DIE SINKING MACHINES
Pratt & Whitney Co., Hartford, Conn.

DIE STOCKS
See Stocks, Dies and Taps and Dies.

DIES, DRAWING, PRESSURE ATTACHMENTS
King, R. D., 1620 Monadnock Block, Chicago.
Marquette Tool & Mfg. Co., 331 West Ohio St., Chicago.

DIES, DROP FORGING
Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y.

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Matthews & Co., James H., Pittsburgh, Pa.
Noble & Westbrook Mfg. Co., Hartford, Conn.

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Adriance Machine Works, Inc., 78 Richards St., Brooklyn, N. Y.
American Tool & Mfg. Co., Urbana, O.
Bliss Co., E. W., Brooklyn, N. Y.
Diamant Tool & Mfg. Co., Inc., Newark, N. J.
Ferracute Mch. Co., Bridgeton, N. J.
Globe Mch. & Stamping Co., Cleveland, O.
Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y.
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Mehl Mch. Tool & Die Co., Roselle, N. J.
Meldrum-Gabrielson Corp., Syracuse, N. Y.
Modern Tool, Die & Mch. Co., Columbus, O.
Pannier Bros. Stamp Co., Pittsburgh.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Toledo Mch. & Tool Co., Toledo, O.
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V & O Press Co., Glendale, Long Island, N. Y.
Waltham Machine Works, Waltham, Mass.

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Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W. Div. Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
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Rogers Works, Inc., J. M., Gloucester City, N. J.
Saunders' Sons, Inc., D., Yonkers, N. Y.

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Eastern Machine Screw Corp., New Haven, Conn.
Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
H & G Works, Eastern Mch. Screw Corp., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesoro, Pa.
Modern Tool Co., Second and State Sts., Erie, Pa.
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National Acme Co., Cleveland.
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Victor Tool Co., Madison & W. M. R. R., Waynesboro, Pa.

DISCS, GRINDING
Badger Tool Co., Beloit, Wis.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Gardner Machine Co., Beloit, Wis.

DIVIDING HEADS
Knight Mchy. Co., W. B., St Louis.
Production Mch. Tool Co., Cincinnati.
See also Milling Machines, Horizontal, Universal.

DRAFTING INSTRUMENTS
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Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.

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Universal Drawing Mch. Co., Cleveland, O.

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Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.
Universal Drawing Mch. Co., Cleveland, O.

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Foote-Burt Co., Cleveland.
Fosdick Mch. Tool Co., Cincinnati.
Garvin Machine Co., Spring and Varick Sts., New York.
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Langelier Mfg. Co., Arlington, Cranston, R. I.
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Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

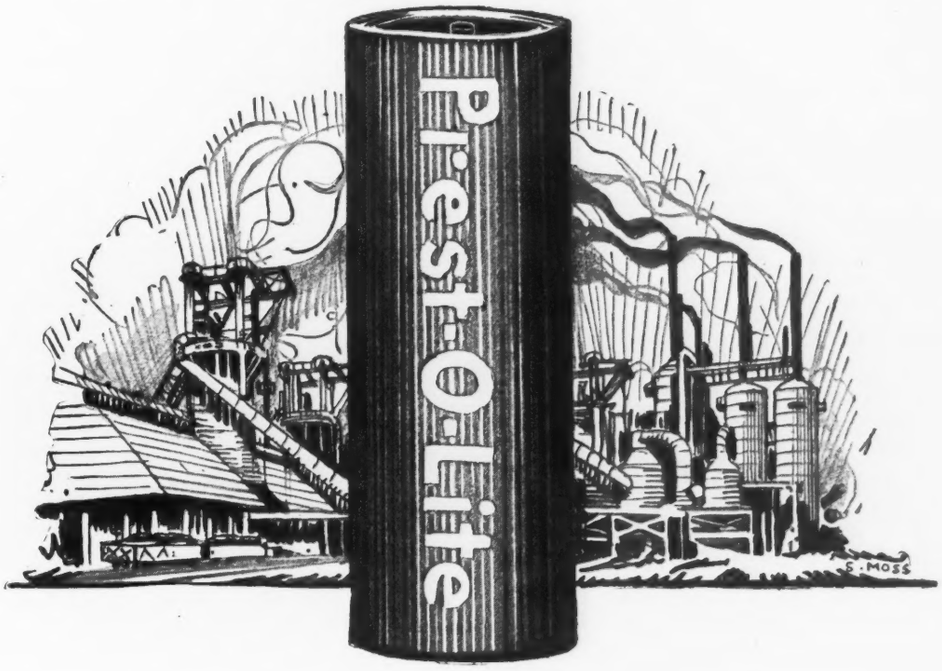
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Foote-Burt Co., Cleveland.
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Moline Tool Co., Moline, Ill.
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Rockford Drilling Machine Co., Rockford, Ill.
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Sipp Machine Co., Paterson, N. J.
Snyder & Son, J. E., Worcester, Mass.

DRILLING MACHINES, WALL RADIAL
Hanna Engineering Works, 1763 Elston Ave., Chicago.

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Read on this page, from issue to issue, a description of the features which have made Prest-O-Lite a national institution



PREST-O-LITE
Reaches You As You Want It
When You Want It Without Delay

The manufacturing and distributing system of Prest-O-Lite embraces forty-eight plants and warehouses placed with a view to meeting every possible requirement from any part of the country without loss of time.

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THE PREST-O-LITE COMPANY, Inc.

General Offices: Carbide and Carbon Building, 30 East 42nd Street, New York
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National Twist Drill & Tool Co., Detroit.
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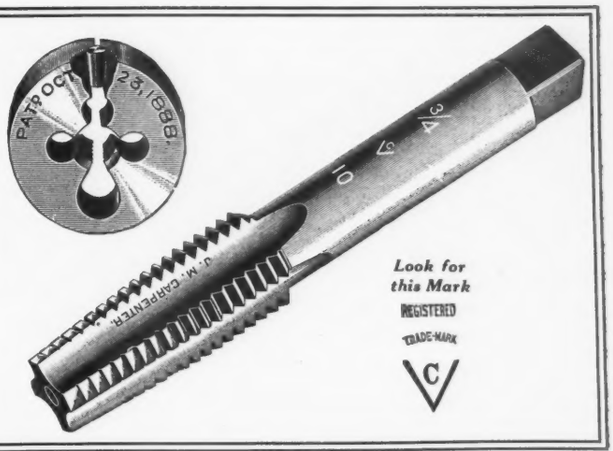
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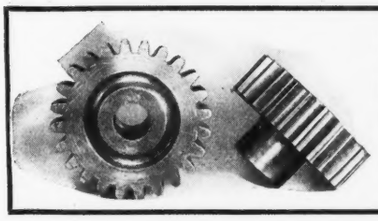
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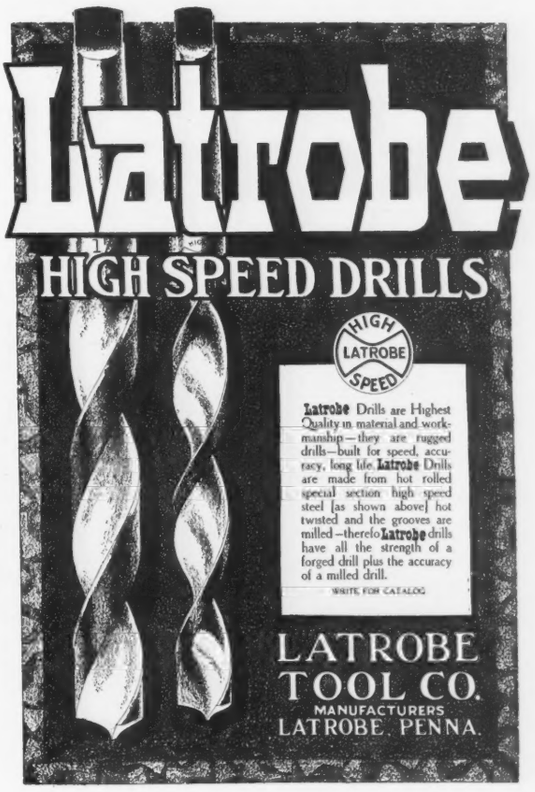
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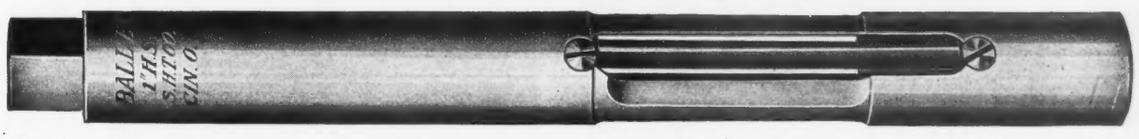
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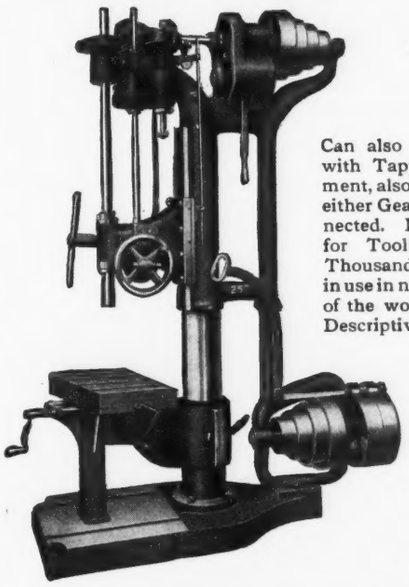
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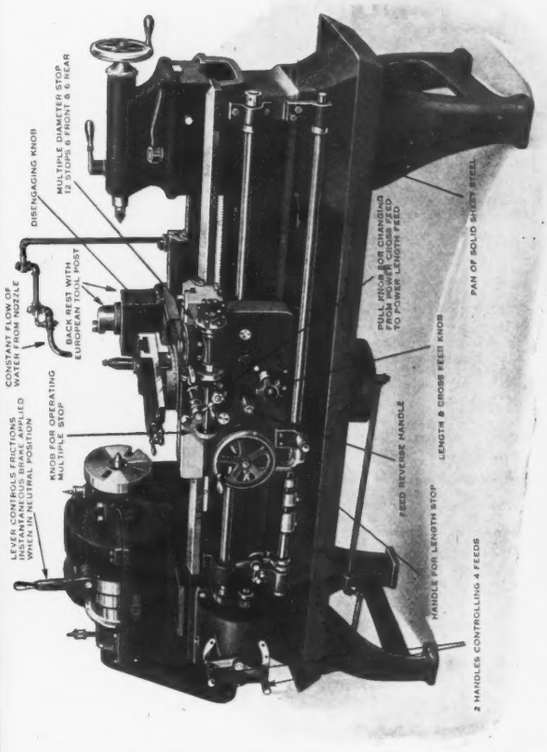
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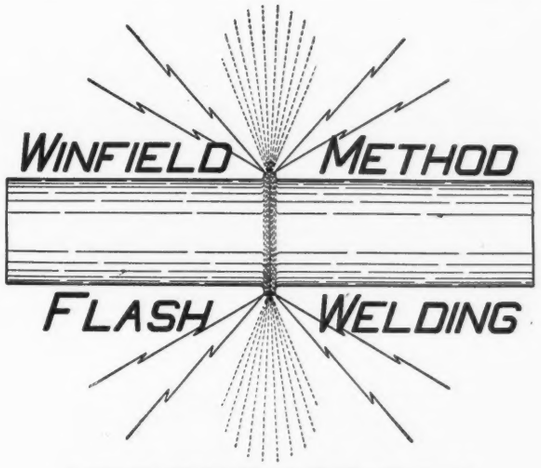
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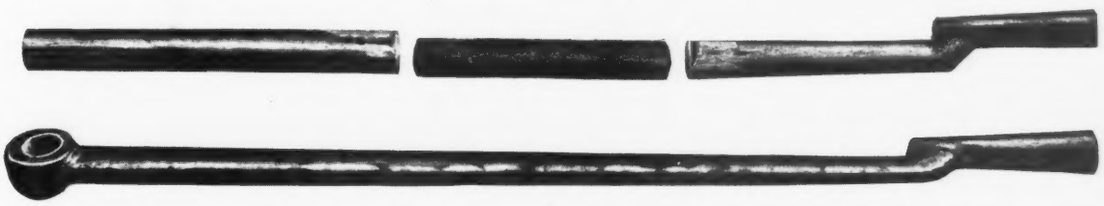
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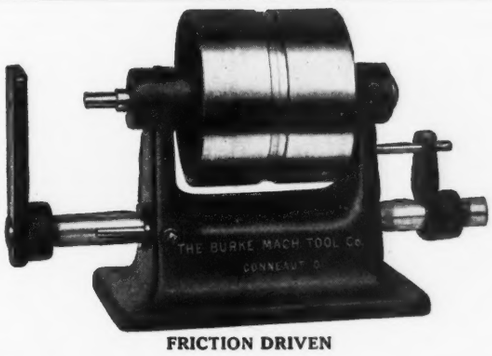


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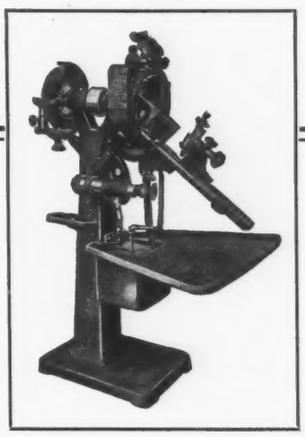
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Rivett Lathe & Grinder Co., Brighton, Boston.
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Dreses Machine Tool Co., Cincinnati.
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Warner & Swasey Co., Cleveland.

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Niles-Bement-Pond Co., 111 Broadway, New York.
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Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
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Cisco Machine Tool Co., Cincinnati.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
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Mueler Machine Tool Co., Cincinnati.
Myers Machine Tool Corp., Columbia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
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Rockford Tool Co., 2400 Eleventh St., Rockford, Ill.
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Ingersoll Milling Machine Co.. Rockford, Ill.
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Oesterlein Mch. Co., Cincinnati.
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Pratt & Whitney Co., Hartford, Conn.
Production Mch. Tool Co., Cincinnati.
Rivett Lathe & Grinder Co., Brighton, Boston.
Rockford Milling Machine Co., Rockford, Ill.
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Taylor & Fenn Co., Hartford, Conn.
Whitney Mfg. Co., Hartford, Conn.

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Pratt & Whitney Co., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

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Taylor & Fenn Co., Hartford, Conn.

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Rockford Milling Machine Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Van Norman Mch. Tool Co., Springfield, Mass.
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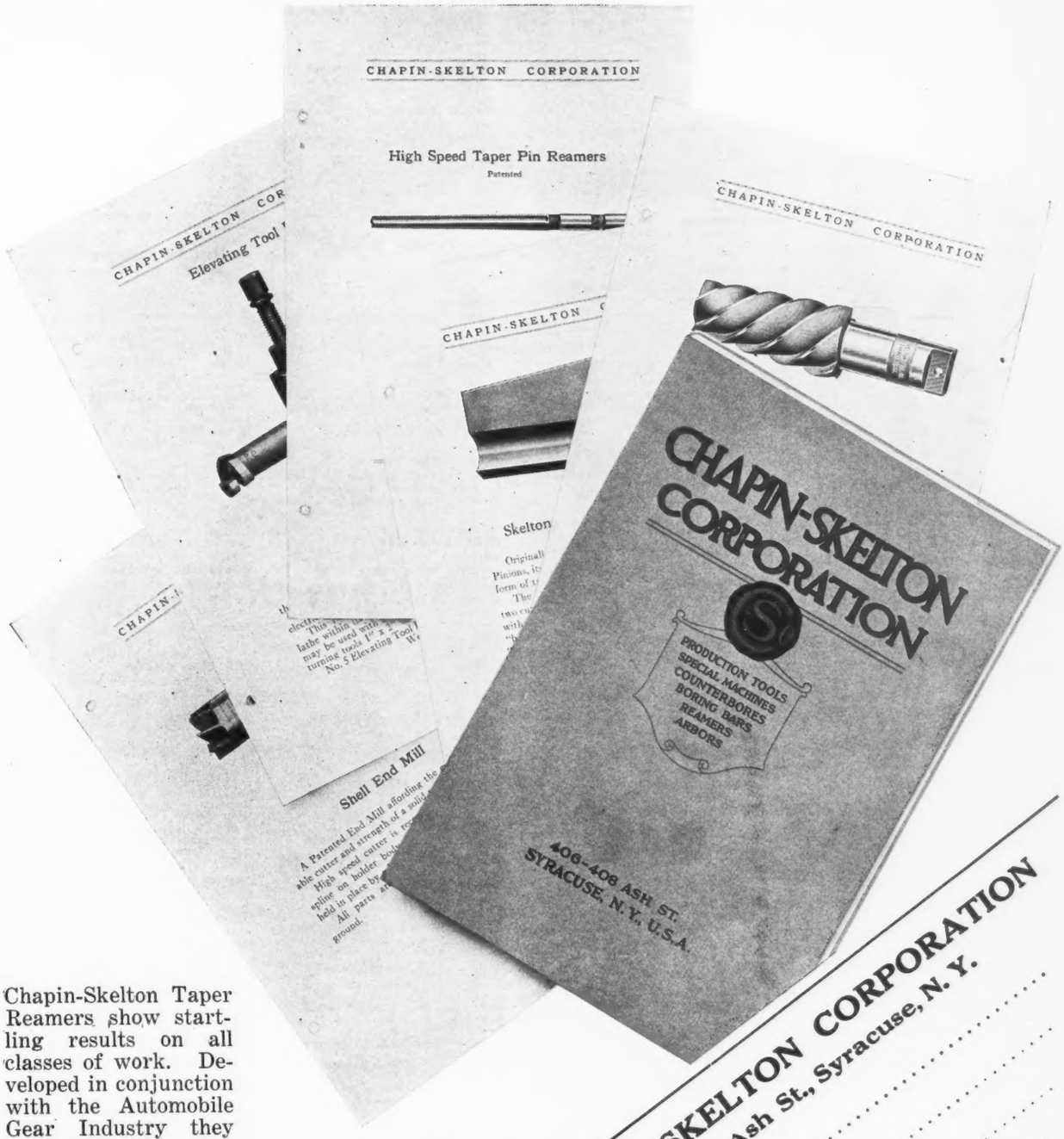
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See Bolt and Nut Machinery

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Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Lucas Machine Tool Co., Cleveland.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.
Watson-Stillman Co., 192 Fulton St., New York.

PRESSES, DROP

See Hammers, Drop

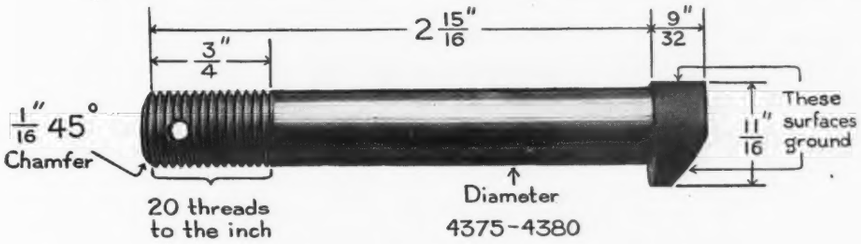
PRESSES, FOOT

Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Baird Mch. Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Etna Machine Co., Toledo, O.
Ferracute Mch. Co., Bridgeton, N. J.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.

ALPHABETICAL INDEX TO ADVERTISERS, PAGES 275-276

SUN OILS

On this "automatic" job cutting oil expense was cut 87%



CONNECTING ROD BEARING BOLT

MATERIAL	
NICKEL	3.25 — 3.75%
CARBON	.25 — .35%
SULPHUR (NOT OVER)	.045%
PHOSPHORUS (NOT OVER)	.04%
MANGANESE	.50 — .80%
SCLEROSCOPE	37 — 43

OPERATIONS

1. ROUGH AND FINISH TO THREAD DIAMETER—ONE CUT.
2. FINISH SHANK—ONE CUT.
3. FACE END AND CHAMFER.
4. CHASE THREAD—OPEN AND CLOSE DIE—20 THREADS TO THE INCH. 7/16' DIAMETER.
5. CUT OFF.

MACHINE—GRIDLEY 4 SPINDLE AUTOMATIC
SPINDLE SPEED—400 R. P. M. PRODUCTION—35 PER HOUR

CUTTING OIL—ONE PART SUN EMULSO, TEN PARTS WATER

Another Sun Emulso achievement

Sun Emulso displaced a straight paraffin oil on this job. The cutting oil expense was cut to 13% of the previous cost. The finish was superior and the tool life was longer. Inspection was easier and general operating conditions were better.

Shop executives have been quick to see the economy of using a soluble oil, where before they had considered a straight cutting oil necessary in automatic machining of chrome nickel steel, 3½% nickel steel and machine stock.

Sun Emulso is a clean and entirely mineral product. It is a true lubricant. If it comes in contact with the machine lubricating system it cannot damage the bearings. The cooling qualities of Sun Emulso increase production and lengthen tool life.

Our cutting engineers will demonstrate in your shop, without charge or obligation, how you can lower your costs by the use of Sun Emulso. Write, phone or wire our nearest office.

SUN COMPANY

Producer and Refiner of Lubricating Oils, Fuel Oil, Gas Oil, and Other Petroleum Products

PHILADELPHIA

Branch Offices and Warehouses

Akron	Boston	Cincinnati	Detroit	Jackson, Mich.	Montreal	St. Louis
Albany	Bridgeport	Cleveland	Flint	Kansas City, Mo.	Newark	Syracuse
Atlanta	Buffalo	Dallas	Grand Rapids	Los Angeles	New York	Toledo
Baltimore	Chicago	Dayton	Indianapolis	Milwaukee	Pittsburgh	Toronto
Battle Creek						

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Ferracute Mch. Co., Bridgeton N. J.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.

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Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
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Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
West Tire Setter Co., Rochester, N. Y.

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Southwark Foundry & Machine Co., Philadelphia.

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Littell Machine Co., F. J., 4125 Ravenswood Ave., Chicago.

PRESSES, SCREW
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Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
Globe Mch. & Stamping Co., Cleveland, O.
Niagara Machine & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.
Toledo Mch. & Tool Co., Toledo, O.

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Baird Mch. Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
King, R. D., 1620 Monadnock Block, Chicago.
Loy & Nawrath, 30 Church St., New York.
Niagara Machine & Tool Works, Buffalo, N. Y.
Southwark Foundry & Machine Co., Philadelphia.
Stoll Co., Inc., D. H., Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.

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Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Southwark Foundry & Machine Co., Philadelphia.
West Tire Setter Co., Rochester, N. Y.

PRESSES, STRAIGHTENING
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Elmes Engineering Works, Charles F., 222 No. Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Southwark Foundry & Machine Co., Philadelphia.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Watson-Stillman Co., 192 Fulton St., New York.

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Niagara Mch. & Tool Co., Buffalo, N. Y.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Glendale, Long Island, N. Y.
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Leland-Gifford Co., Worcester, Mass.
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Pratt & Whitney Co., Hartford, Conn.

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Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
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Sellers & Co., Inc., Wm., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

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PUMPS, PNEUMATIC
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Leader-Trahern Co., Rockford, Ill.

PUMPS, ROTARY
Leader-Trahern Co., Rockford, Ill.

PUMPS, STEAM
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Ingersoll-Rand Company, 11 Broadway, New York.

PUMPS, TURBINE DRIVEN
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.

PUMPS, VACUUM
Leiman Bros., 81 Walker St., N. Y.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

PUNCHES, PIN DRIVING
Goodell-Pratt Co., Greenfield, Mass.

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Machinery Co. of America, Big Rapids, Mich.
Mitts & Merrell, 843 Water St., Saginaw, Mich.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Royersford Foundry & Machine Co., 54 North 5th St., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.
Union Mfg. Co., New Britain, Conn.
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Taylor Instrument Companies, Rochester, N. Y.
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Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, 25, Mass.
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Nuttall Co., R. D., Pittsburgh.
Philadelphia Gear Works, Philadelphia.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Mch. Co., Cleveland.
Standard Gauge Steel Co., Beaver Falls, Pa.

RACKS, STOCK, TOOL AND PATTERN
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Western Tool Mfg. Co., Springfield, Ohio.

RACKS, TOOL
See Racks, Stock, Tool and Pattern.

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Victor Tool Co., Madison and W. M. R. R., Waynesboro, Pa.

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Card Mfg. Co., S. W. Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
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Detroit Twist Drill Co., Detroit.
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McCroskey Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
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Schellenbach-Hunt Tool Co., Cincinnati.
Whitman & Barnes Mfg. Co., Akron, Ohio.

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Davis Boring Tool Co., Inc., St. Louis.
Detroit Twist Drill Co., Detroit.
Gisholt Machine Co., 9 So. Baldwin St., Madison, Wis.
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Hanniffin Mfg. Co., Kolmar Ave. and Lexington St., Chicago.
Kruce & Co., E. J., Detroit.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Schellenbach-Hunt Tool Co., Cincinnati.
Wetmore Reamer Co., Milwaukee, Wis.
Whitman & Barnes Mfg. Co., Akron, Ohio.

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Gammons-Holman Co., Manchester, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

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Brown Instrument Co., Philadelphia.
General Electric Co., Schenectady, N. Y.

RECORDING INSTRUMENTS FOR PRESSURE
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia.

RECORDING INSTRUMENTS FOR SPEED
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia.

RECORDING INSTRUMENTS FOR TEMPERATURE
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia.
Wilson Maeulen Co., 763 East 143rd St., New York.

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Brown Instrument Co., Philadelphia.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.

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General Electric Co., Schenectady, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

REGULATORS, TEMPERATURE
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General Electric Co., Schenectady, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

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Monitor Controller Co., Baltimore, Md.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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Diamond Mch. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

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Johnston & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.
Machinery Forging Co., Cleveland.

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Niles-Bement-Pond Co., 111 Broadway, New York.
Southwark Foundry & Machine Co., Philadelphia.

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Ingersoll-Rand Co., 11 Broadway, New York.
Southwark Foundry & Machine Co., Philadelphia.

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Hanna Engineering Works, 1763 Elston Ave., Chicago.

RIVETING MACHINES
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Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
High Speed Hammer Co., Inc., Rochester, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Shuster Co., F. B., New Haven, Conn.

RIVET SETS
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ROD CUTTING MACHINES
Union Mfg. Co., New Britain, Conn.

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Ajax Mfg. Co., Cleveland.
Williams, White & Co., Moline, Ill.

ROLLING MILL MACHINERY
Ajax Mfg. Co., Cleveland.
Fawcus Machine Co., Pittsburgh.

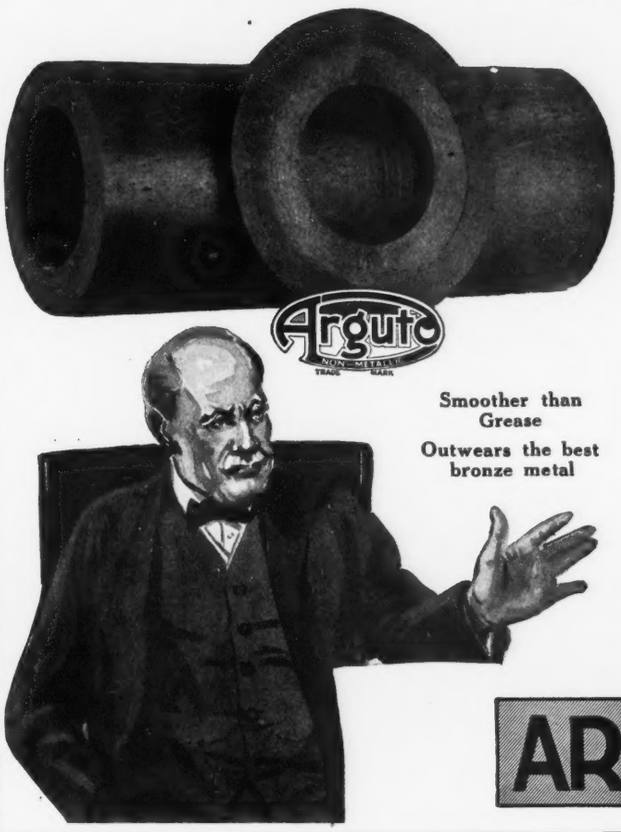
ROPE DRESSING AND PRESERVATIVE
Link-Belt Company, Chicago.

ROPE DRIVES
Cresson-Morris Co., Philadelphia.
Link-Belt Company, Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

RULES, STEEL
Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.

ALPHABETICAL INDEX TO ADVERTISERS, PAGES 275-276

An Illustration of How ARGUTO Oilless Bearings Lower Your Manufacturing Costs



In sending in one of several repeat orders, a user writes:—

"Before using ARGUTO, we had to re-babbitt these sleeves every few weeks.
"The original installation of ARGUTO Bushings was made nearly five years ago and today they seem to be as good as when first put in. They certainly have relieved us of a lot of bother, trouble and expense."

On an average the metal bushings had to be re-babbitted every six weeks at an approximate cost of about $2.40 per bearing—more than the cost of an ARGUTO. There were six ARGUTOS in the first installation and the old type bearings would have been re-babbitted 30 times in the same period.

Figure the savings for yourself:—

30 x 2.40 = $72.00 saved per bearing
6 bearings = $432.00 total saved by six ARGUTOS

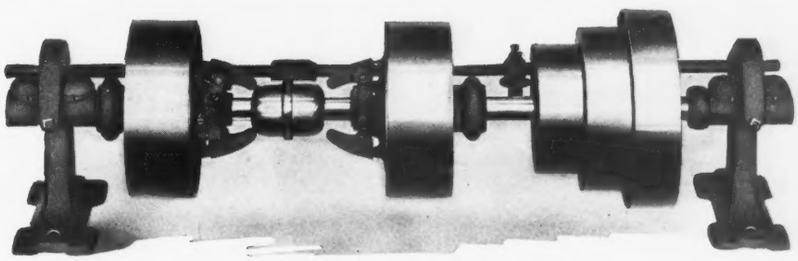
How many bearings in your plant? Figure up the savings you could make and then write for a trial order to the

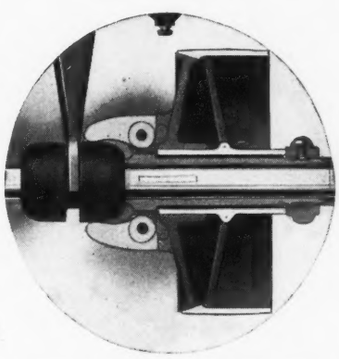
Arguto Oilless Bearing Company
Pioneer Manufacturers of Oilless Bearings
145 W. Berkley St. Wayne Junction, Philadelphia

ARGUTO OILLESS BEARINGS

Twenty Years of Successful Performances Back of

B & O Friction Countershafts





Seven Sizes—7' to 18' diameter
Two or Three Speeds
Sold Complete or in Parts

Between high speeds and constant starting and stopping, turret lathes exact a full measure of service from their countershafts. B. & O. countershafts are designed for this special purpose and make good on every count—efficiency, economy and durability.

We invite comparison—point by point—with similar equipment of any make; and are satisfied to leave the decision in your hands.

Send for the circular and location of nearest factory where you can see them on the job; or, better still, try one and make the comparison in your own plant.

BARDONS & OLIVER of Cleveland, Ohio

Goodell-Pratt Co., Greenfield, Mass.
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

RUST PREVENTIVE

Oakley Chemical Co., 26 Thames St., New York.

SAND BLAST EQUIPMENT

Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Leiman Bros., 81 Walker St., N. Y.

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Napier Saw Works, Inc., Middletown, N. Y.
Simonds Mfg. Co., Fitchburg, Mass.

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Barnes Co., W. O., Detroit.
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Goodell-Pratt Co., Greenfield, Mass.
Napier Saw Works, Inc., Middletown, N. Y.
Simonds Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.
Thompson & Son Co., Henry G., New Haven, Conn.

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Huther Bros. Saw Mfg. Co., Rochester, N. Y.
Napier Saw Works, Inc., Middletown, N. Y.
Simonds Mfg. Co., Fitchburg, Mass.
Thompson & Son Co., Henry G., New Haven, Conn.

SAW BLADES, SCREW SLOTTING

Atkins & Co., Inc., E. C., Indianapolis, Ind.
Greenfield Tap & Die Corp., Greenfield, Mass.

SAW FRAMES, HACK

Atkins & Co., Inc., E. C., Indianapolis, Ind.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Napier Saw Works, Inc., Middletown, N. Y.
Simonds Mfg. Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.
Thompson & Son Co., Henry G., New Haven, Conn.

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Machinery Co. of America, Big Rapids, Mich.

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Burr & Son, John T., Brooklyn, N. Y.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
Espen-Lucas Machine Works, Philadelphia, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Newton Machine Tool Works, Inc., Philadelphia.
Vandyck Churchill Co., 149 Broadway, New York.

SAWING MACHINES, FRICTION

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Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.

SAWING MACHINES, METAL CUTTING BAND

Ajax Mfg. Co., Cleveland, O.
Armstrong-Blum Mfg. Co., 343 North Francisco Ave., Chicago.
Atkins & Co., Inc., E. C., Indianapolis, Ind.
Machinery Co. of America, Big Rapids, Mich.
Racine Tool & Mch. Co., Racine, Wis.
Thompson & Son Co., Henry G., New Haven, Conn.

SAWING MACHINES, POWER HACK

Armstrong-Blum Mfg. Co., 343 North Francisco Ave., Chicago.
Atkins & Co., Inc., E. C., Indianapolis, Ind.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Myers Mch. Tool Corp., Columbia, Pa.
Napier Saw Works, Inc., Middletown, N. Y.
Peerless Mch. Co., Racine, Wis.
Racine Tool & Mch. Co., Racine, Wis.
Thompson & Son Co., Henry G., New Haven, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

SAWING MACHINES, WOOD

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Crescent Machine Co., 56 Main St., Leetonia, O.
Woods Engineering Co., Alliance, O.

SAW SHARPENING MACHINES

Hanna Engineering Works, 1763 Elston Ave., Chicago.
Hunter Saw & Mch. Co., Pittsburgh.
Machinery Co. of America, Big Rapids, Mich.
Scherr, George, 126 Liberty St., New York.
Wardwell Mfg. Co., Cleveland.

SAW TABLES

Baker Bros., Toledo, O.
Crescent Machine Co., 56 Main St., Leetonia, O.

SAWS, METAL CUTTING HAND

Atkins & Co., Inc., E. C., Indianapolis, Ind.

SCRAPING TOOLS, BEARING

Goodell-Pratt Co., Greenfield, Mass.

SCRAPING TOOL, METAL POWER DRIVEN

Anderson Bros. Mfg. Co., Rockford, Ill.

SCREENS, PERFORATED

Chicago Perforating Co., 2445 West 24th Place, Chicago.

SCREW CUTTING TOOLS

See Taps and Dies.

SCREW DRIVING MACHINES

Reynolds Machine Co., Massillon, O.

SCREW MACHINES, AUTOMATIC

Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland.
Cone Automatic Mch. Co., Inc., Windsor, Vt.
National Acme Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.

SCREW MACHINES, HAND

See also Lathes, Turret.
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dreses Machine Tool Co., Cincinnati.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
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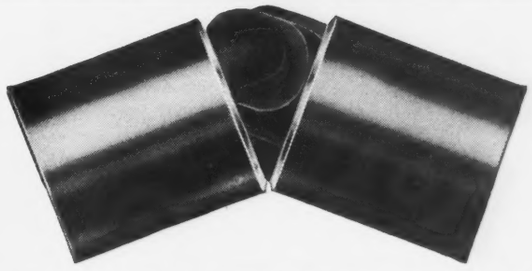
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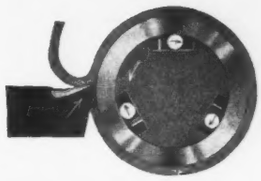
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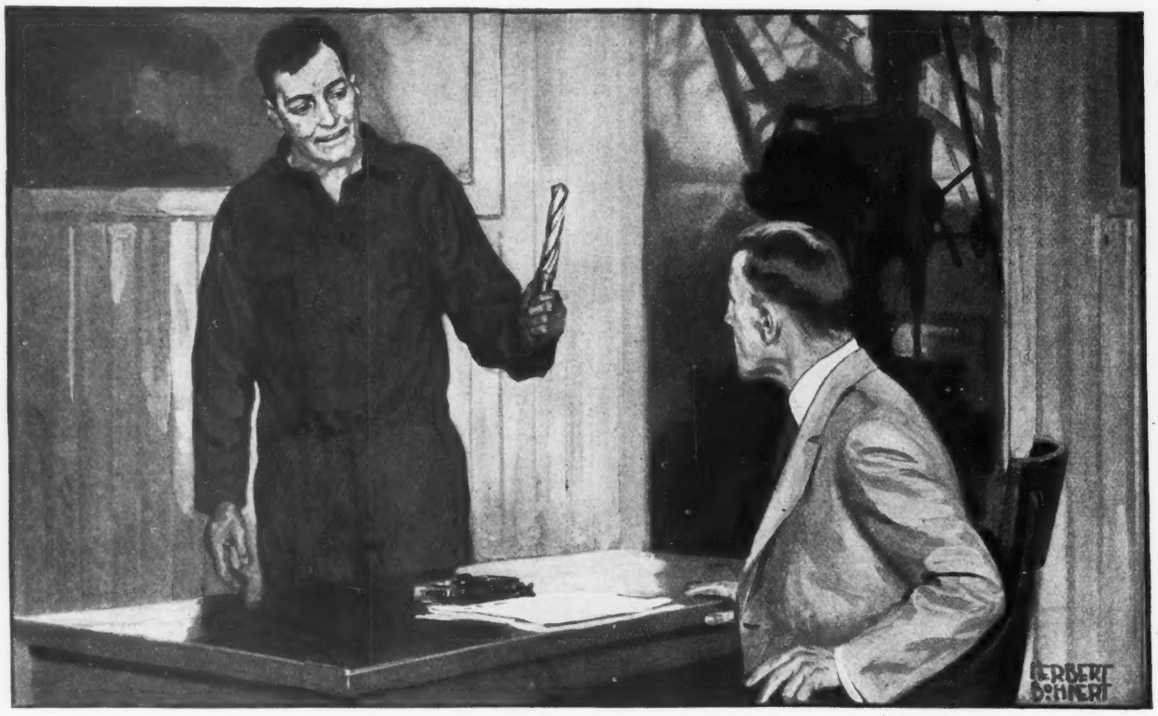
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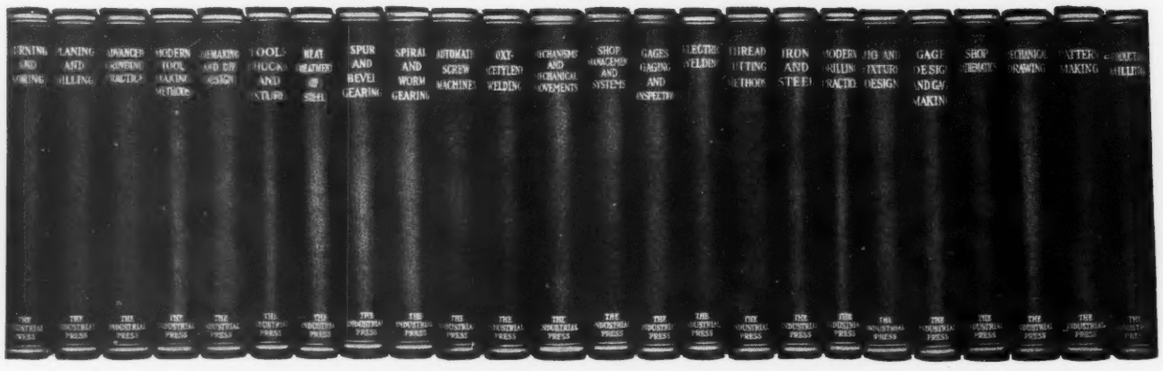
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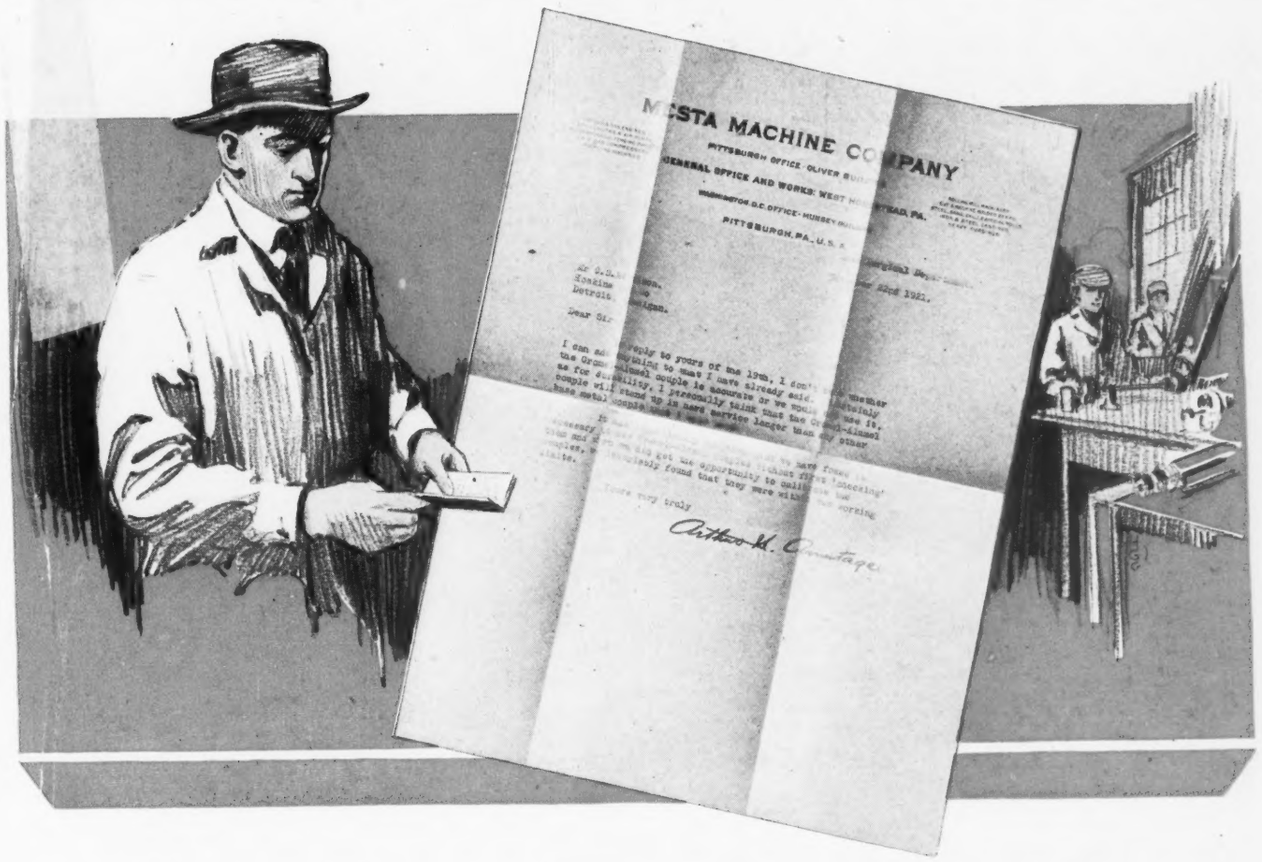
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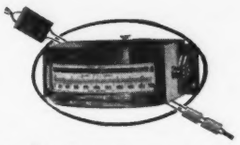
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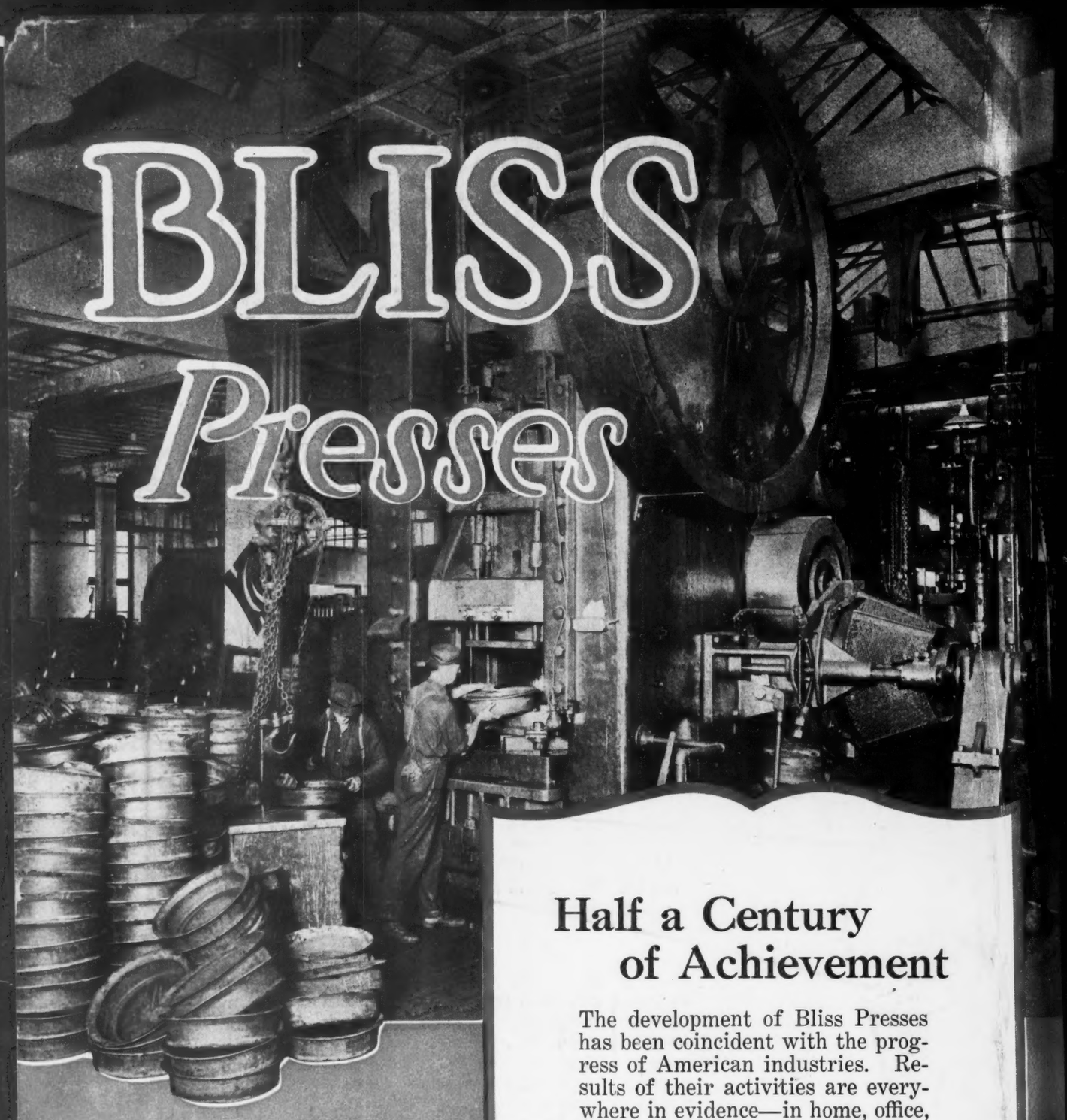
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